# CIVIL ENGINEERING

DECEMBER 1958

THE MAGAZINE OF ENGINEERED CONSTRUCTION

FLOATING DERRICK TOWER
maneuvers 280-ton girder assembly into
Craig Memorial Bridge, Toledo, Ohio.
See article by McDowell.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

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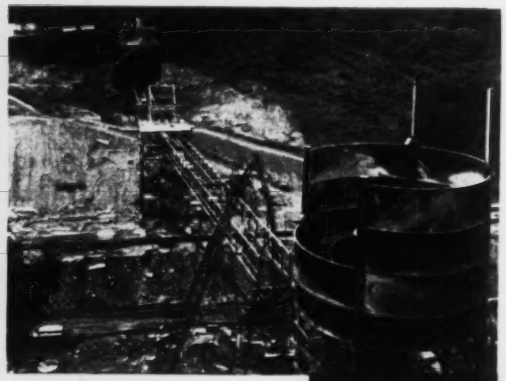
# 100 MILLION DOLLARS OF CONSTRUCTION REQUIRING 12,300 TONS OF STRUCTURAL STEEL

## BRISTOL STEEL Fabricated Each of These Structures



Coal handling facilities at portals of Clinchfield Coal Company's Moss No. 3 Mine at Duty, Virginia—1800 tons of structural steel designed, fabricated and erected by Bristol Steel.

Clinchfield Coal Company's Moss No. 3 coal preparation plant, at Clinchfield, Virginia. Design and construction by Link-Belt Company—3000 tons of structural steel fabricated by Bristol Steel.

If you don't have our 50th Anniversary Brochure won't you write today?

Appalachian Power Company's 450,000 KW Clinch River Power Plant, at Carbo, Va.—7500 tons of structural steel fabricated and erected by Bristol Steel.

THE three major projects pictured on this page, all interrelated and dovetailed into $100 million of construction, *will start operation this year on schedule!* Bristol Steel fabricated all of the more than 12,300 tons, erected over 9,300 tons and designed some 1,800 tons of the structural steel for these projects. *When schedules are tight, you can count on Bristol Steel* . . . Won't you let us work with you on your next requirement for structural steel?

# BRISTOL STEEL AND IRON WORKS, INC.

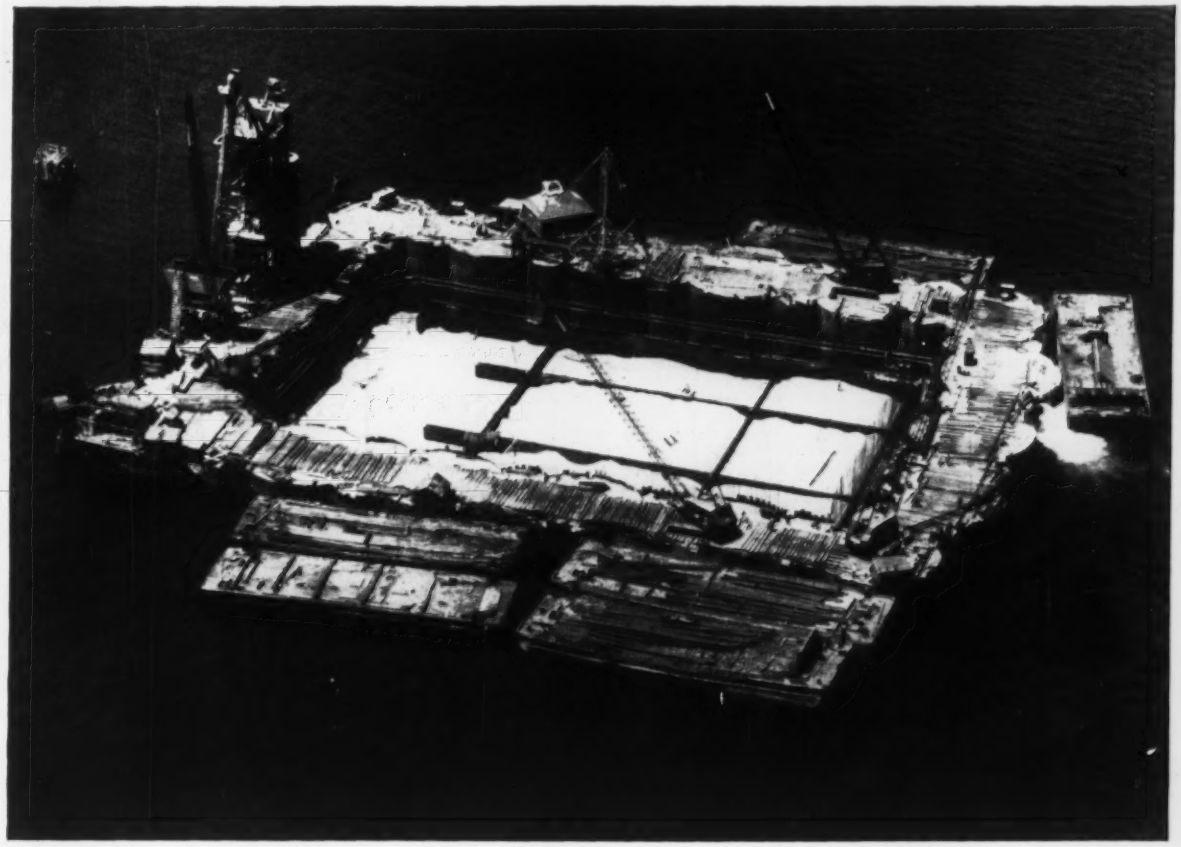
BRISTOL VIRGINIA

AISC
AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC.
FOUNDED 1921

# HOW TO HANDLE WET JOBS

*#44 of a Series*

*Project:* Queens Anchorage, Throgs Neck Bridge, New York City
*Contractor:* Steers-Snare, *a joint venture*
*Engineers:* Ammann & Whitney



**Sinking of huge bridge caisson speeded after wellpoints...**

## Dewater Man-Made Island 30 ft Below River

In order to sink this giant caisson a cofferdam-enclosed sand island was required. (See photo). Confident that wellpointing would result in a time and money-saving operation, Steers-Snare built the island not up to river level (which was the preliminary plan) but 25 ft below.

• **This greatly reduced** the yardage of sand fill, thereby eliminating additional excavation later on. However, Griffin engineers were confronted with a difficult dewatering job, since investigations indicated many unusual problems of soil mechanics, hydraulics and stability.

• **Solution? A specially designed** Griffin wellpoint system which attained absolute control of ground water and uplift pressure and insured the stability of the cofferdam.

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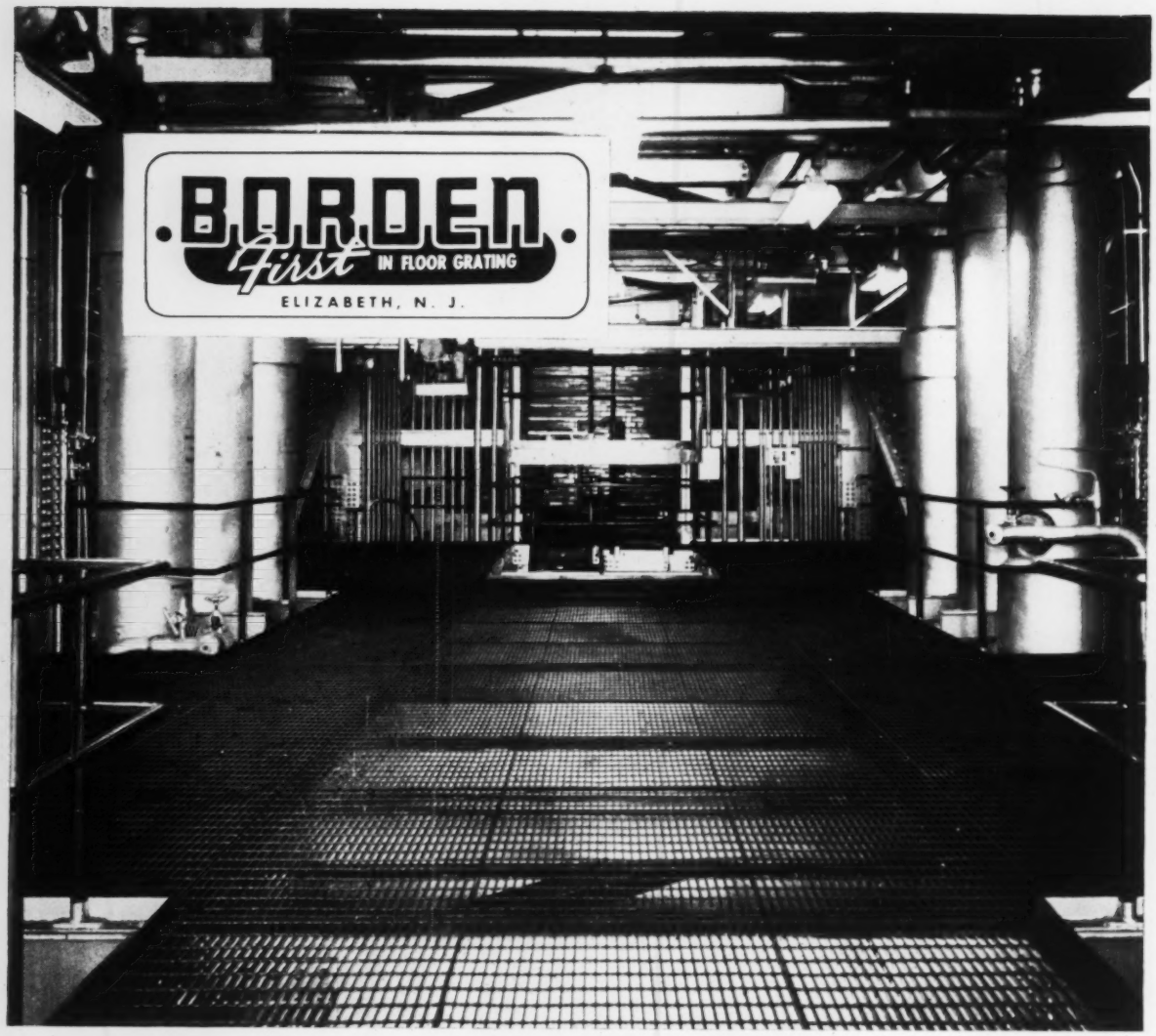


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# CIVIL ENGINEERING

DECEMBER 1958
VOL. 28 • NO. 12

***THE MAGAZINE OF ENGINEERED CONSTRUCTION***

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**Here is the proof!*

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| LOCATION | SIZE | TEST SECT. IN FEET | VELOCITY F.P.S. | AGE YEARS | W & H "C" FACTOR |
|---|---|---|---|---|---|
| Bowling Green, Ohio | 20" | 45,592 | 0.7-2.4 | New | 142.5 |
| Chicago, Illinois | 36" | 7,200 | 2.6-3.6 | New | 147 |
| New Orleans, La. | 12" | 39,650 | 1.2-2.9 | New | 141 |
| Corder, Mo. | 8" | 21,350 | 0.9-2.3 | New | 143 |
| Univ. of Illinois | 8" | 400 | 3.14 | New | 150 |
| Concord, New Hamp. | 14" | 500 | 1.7-2.2 | New | 151 |
| Concord, New Hamp. | 12" | 500 | 2.0-3.4 | 11 | 142 |
| West Palm Beach, Fla. | 12" | 500 | 3.6-5.4 | 15 | 139.5 |
| Greenville, S. C. | 30" | 87,376 | 2.4-2.7 | 12 | 148.5 |
| Corpus Christi, Tex. | 30" | 65,641 | 1.1-1.8 | 6 | 146 |
| Summerville, S. C. | 8" | 500 | 1.98-2.43 | 13 | 142.5 |
| Champaign, Illinois | 16" | 3,920 | 3.1-5.6 | 22 | 139.3 |

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

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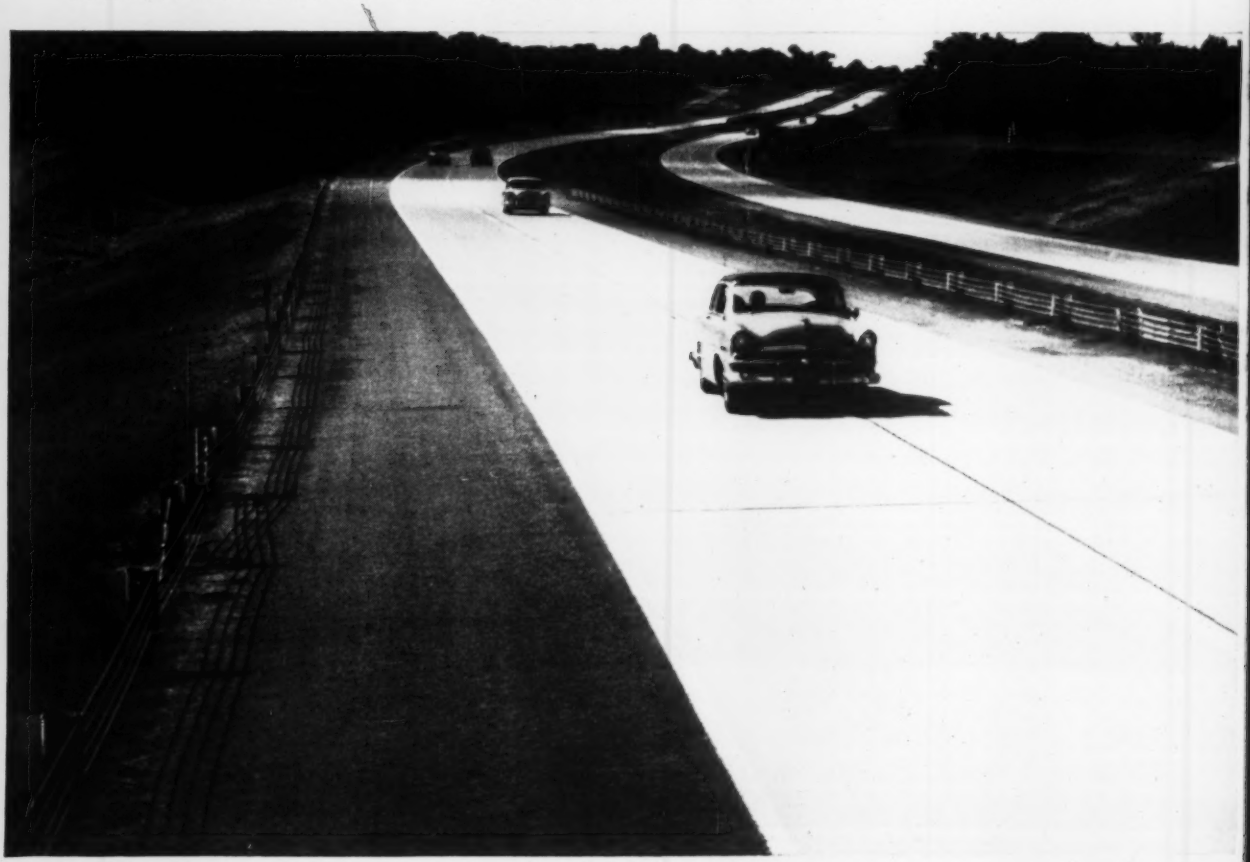

# Wire Fabric

and many other new superhighways are reinforced with American Welded Wire Fabric. Whether you are building a giant freeway or a city street, be sure to guarantee yourself the maximum in road life and the minimum in maintenance by reinforcing your pavement with American Welded Wire Fabric. For complete technical details, write to American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio.

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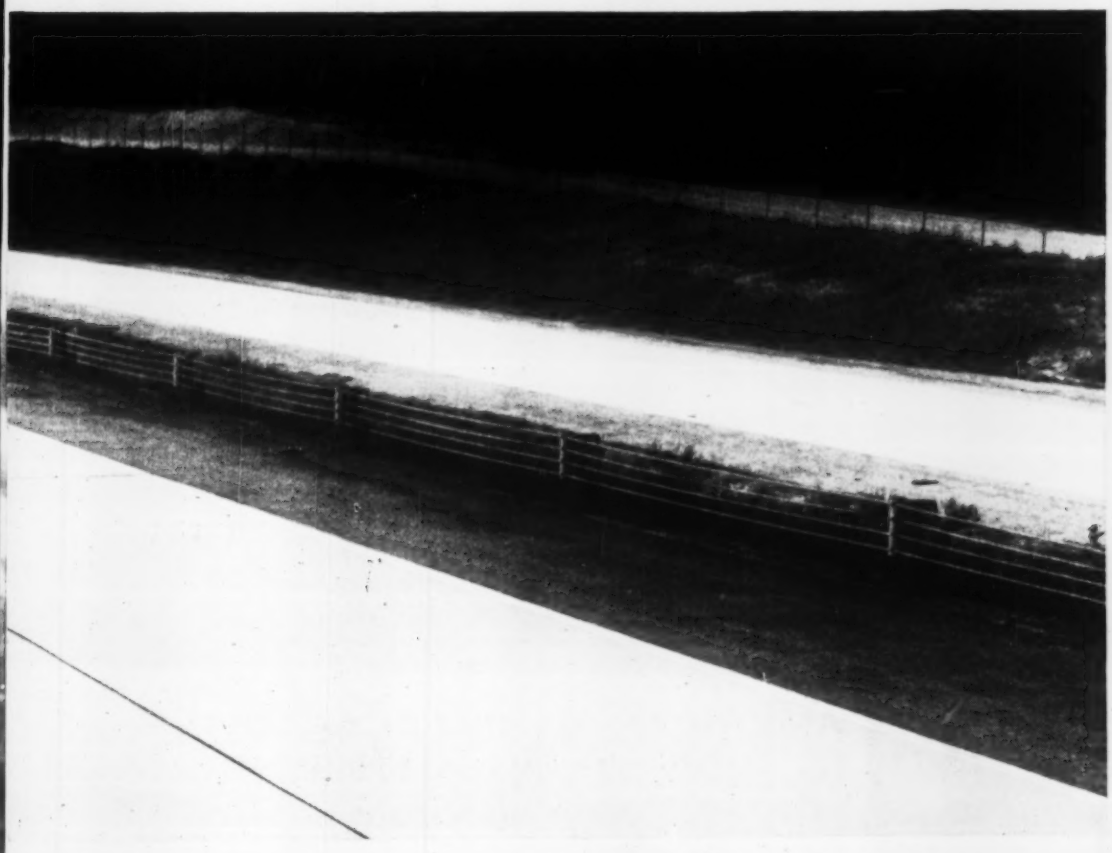
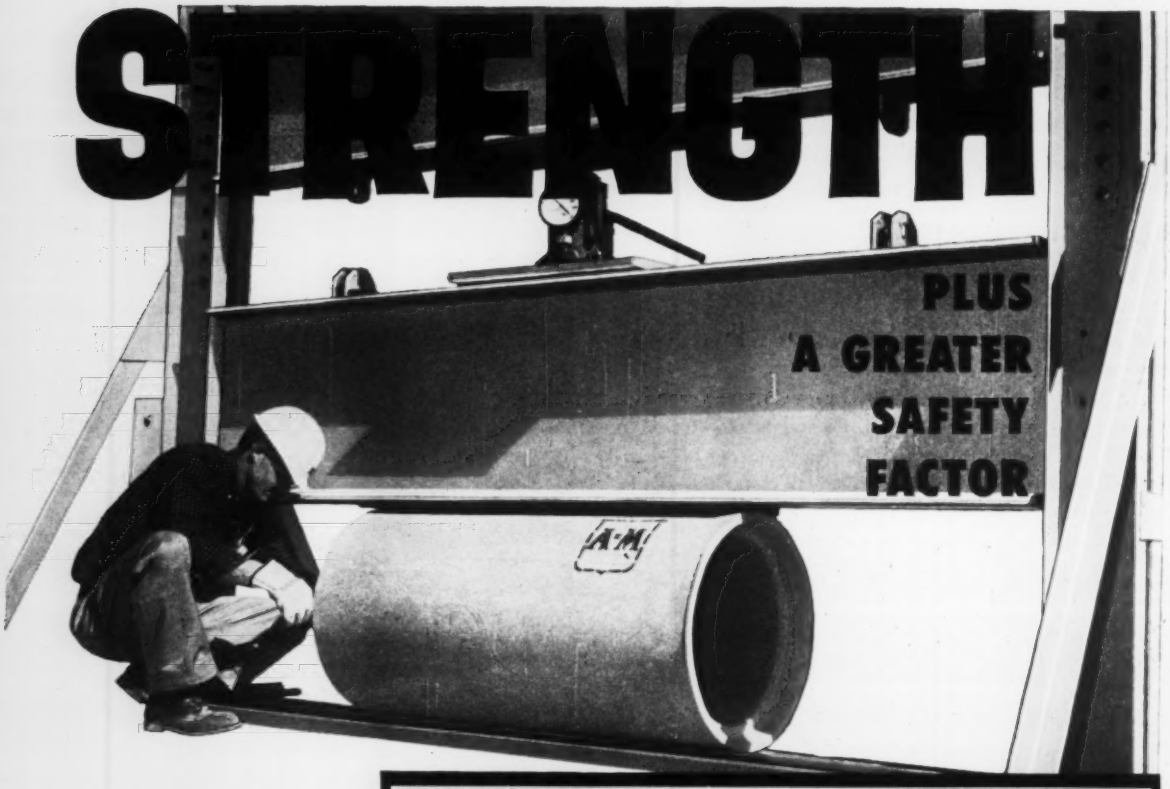


# STRENGTH

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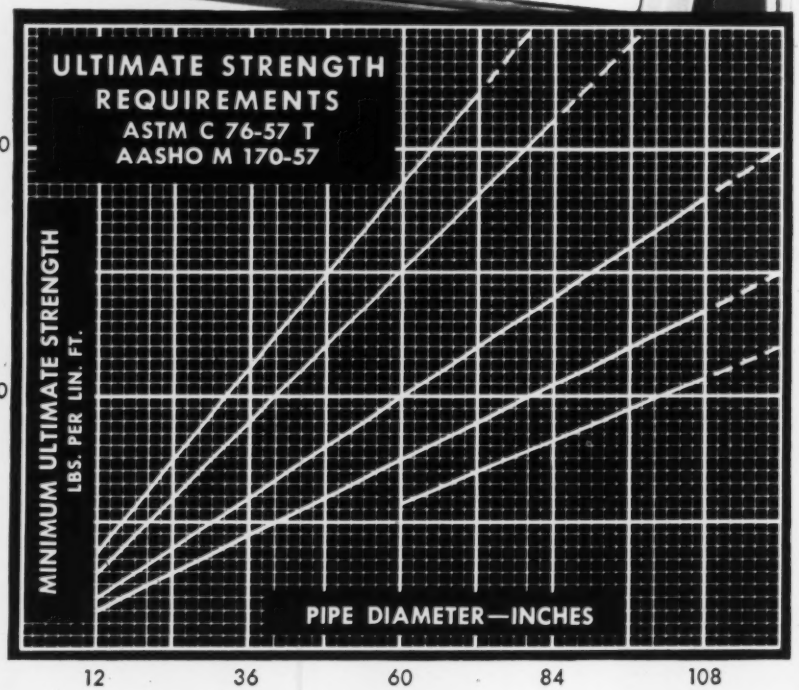


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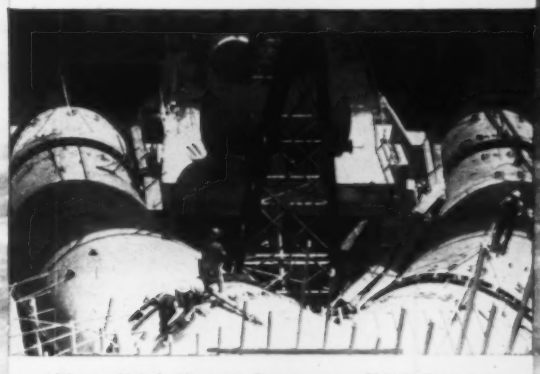
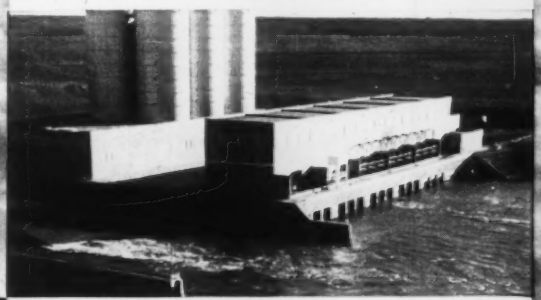
Write the nearest CB&I office for details. Ask for the *Blakely Mountain Dam* story.



*Wye at Blakely Mountain Dam* connects CB&I built power conduit, two penstocks and 149-foot high surge tank.



*Six Surge tanks at Garrison Dam* were fabricated and erected by CB&I to help control turbulence of the "Mighty Missouri" River. They are 65 ft. in dia. by 135 ft. high.

*CB&I Shop Fit-up of T-1 Scroll Case*—one of the largest ever built—for Noxon Rapids Dam. T-1 alloy construction of 24-ft. diam. case saved 50% in plate thickness. Reassembled and welded at site by a CB&I crew.

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*says Consulting Engineer*
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*Yost and Gardner, Engineers*
*Phoenix, Arizona*

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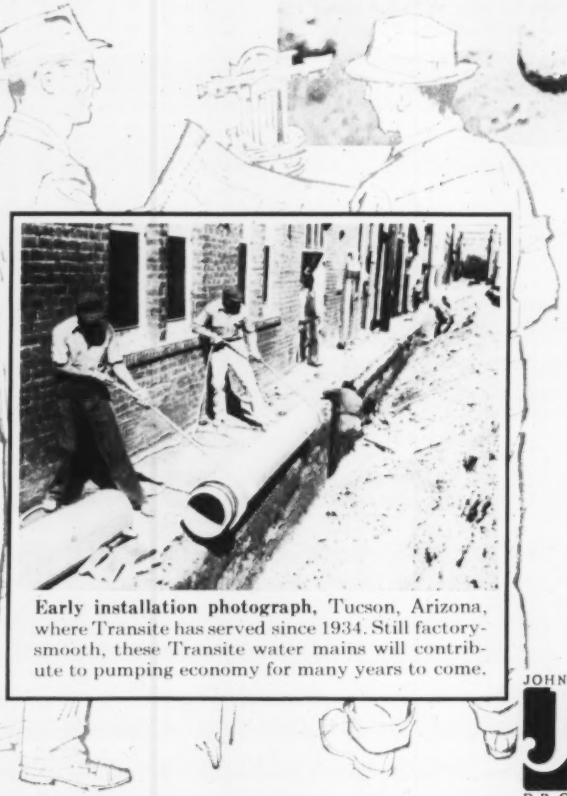



**Early installation photograph,** Tucson, Arizona, where Transite has served since 1934. Still factory-smooth, these Transite water mains will contribute to pumping economy for many years to come.

JOHNS-MANVILLE
JM
PRODUCTS

Photo by Ray Manley, Tucson

Crews of F. J. Gallagher Trenching Co. installing 14" line in Tucson, Arizona

## The lasting smoothness of Transite Pressure Pipe lowers operating costs . . . lets you cut installed costs, too!

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The Ring-Tite® Coupling lets you effect further savings: speeds installation to save time and labor costs; eliminates need for complicated equipment; assures tight seal at every coupling in the system.

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**Transite's Ring-Tite Coupling assures a tight, lasting seal!**

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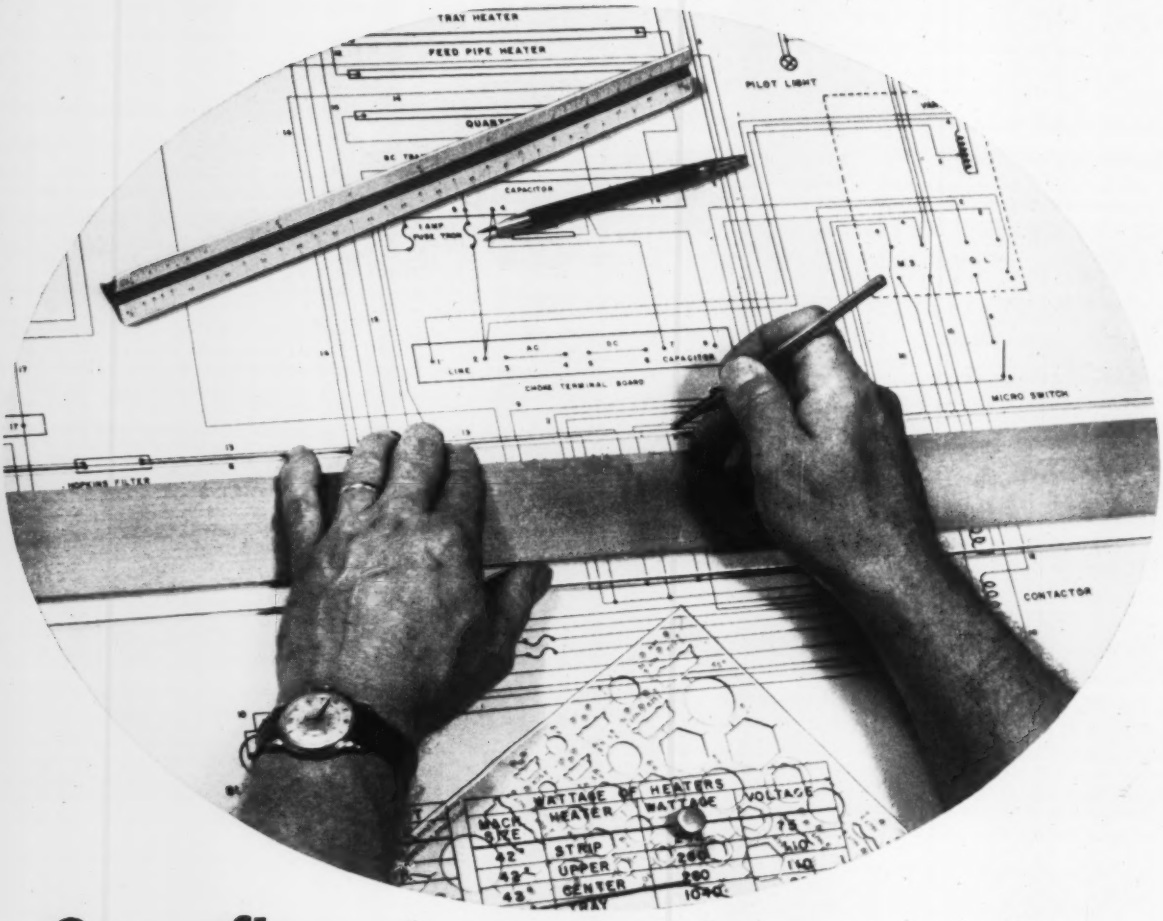


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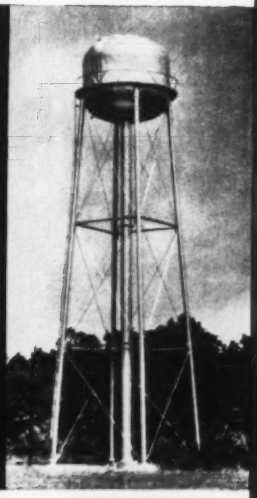

HANOVER, VIRGINIA
60,000 gallons

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ELEVATED STEEL TANKS

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Pittsburgh-Des Moines' resources as pioneer builders of steel elevated tanks include every type of structure, in every capacity to meet your individual water storage needs—fabricated and erected with expert craftsmanship and a responsible guarantee of satisfaction.
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FOREST, MISSISSIPPI. 500,000 gallons

PUEBLO, COLORADO. 1,500,000 gallons

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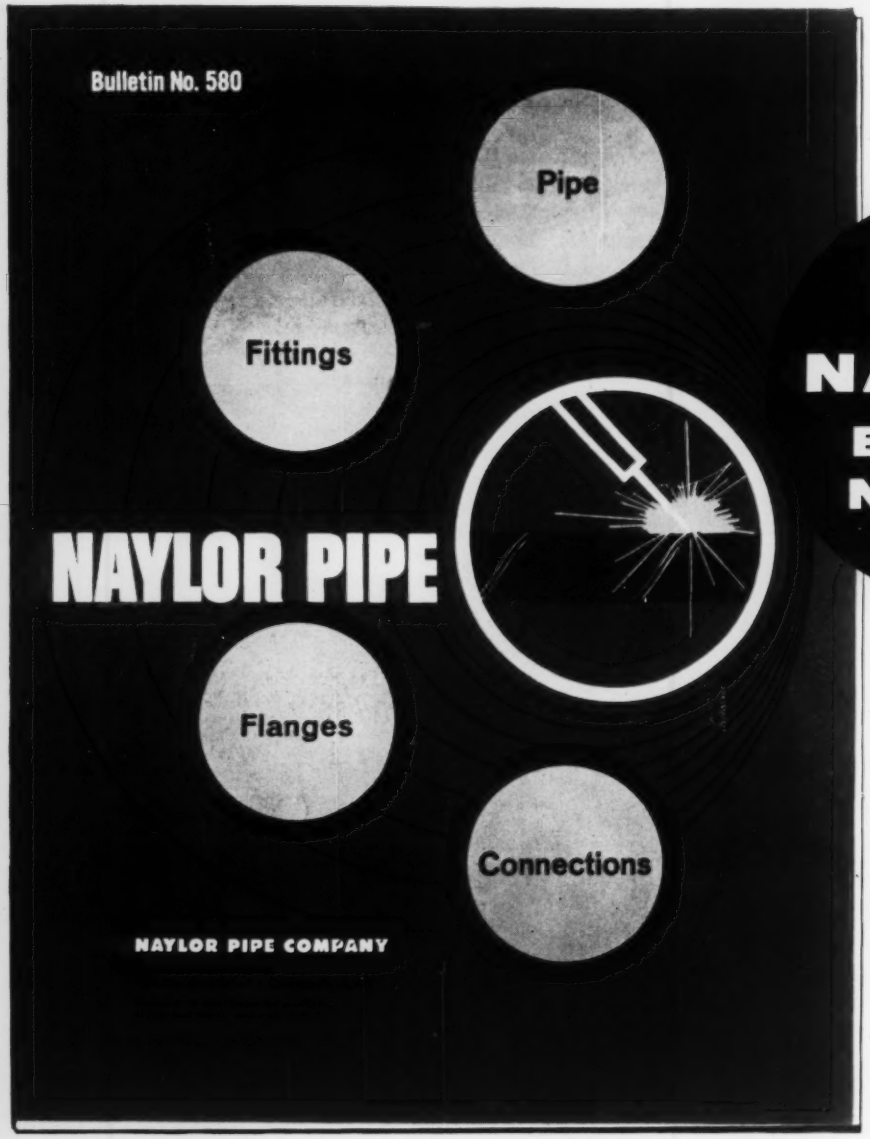
# Helps ANSWER Your PIPE PROBLEMS




**Write for NAYLOR Bulletin No. 580**

Here in concise form is helpful data covering NAYLOR pipe, fittings and connections for use in the construction field. Bulletin No. 580 includes standard specifications on NAYLOR Spiralweld pipe in sizes from 4" to 30"; standard fittings and welding flanges carried in stock; NAYLOR Wedgelock couplings and all types of connections to meet pipe line needs. Write for your copy today.

**NAYLOR PIPE Company**

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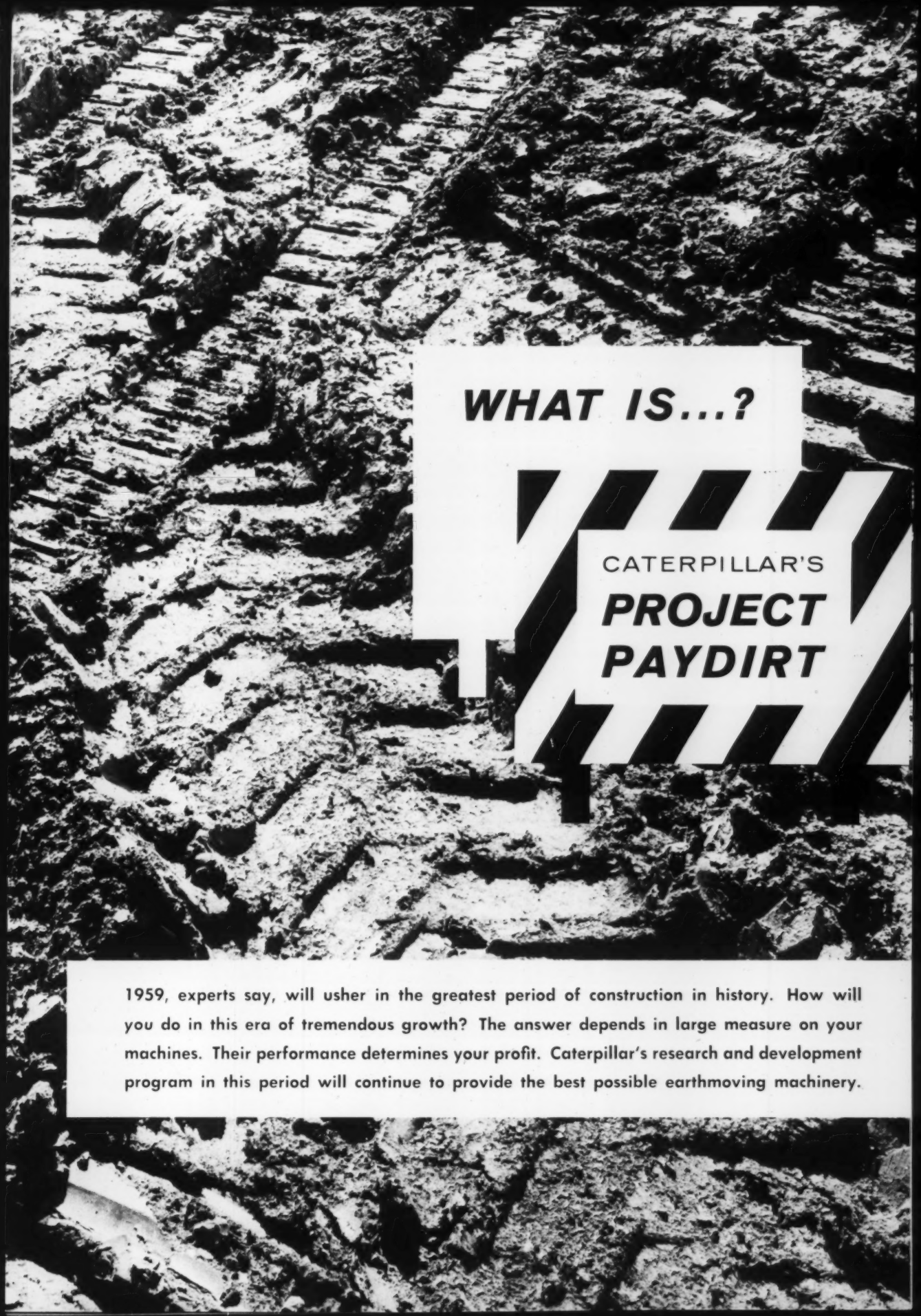



1959, experts say, will usher in the greatest period of construction in history. How will you do in this era of tremendous growth? The answer depends in large measure on your machines. Their performance determines your profit. Caterpillar's research and development program in this period will continue to provide the best possible earthmoving machinery.

CATERPILLAR'S PROJECT PAYDIRT

# Project

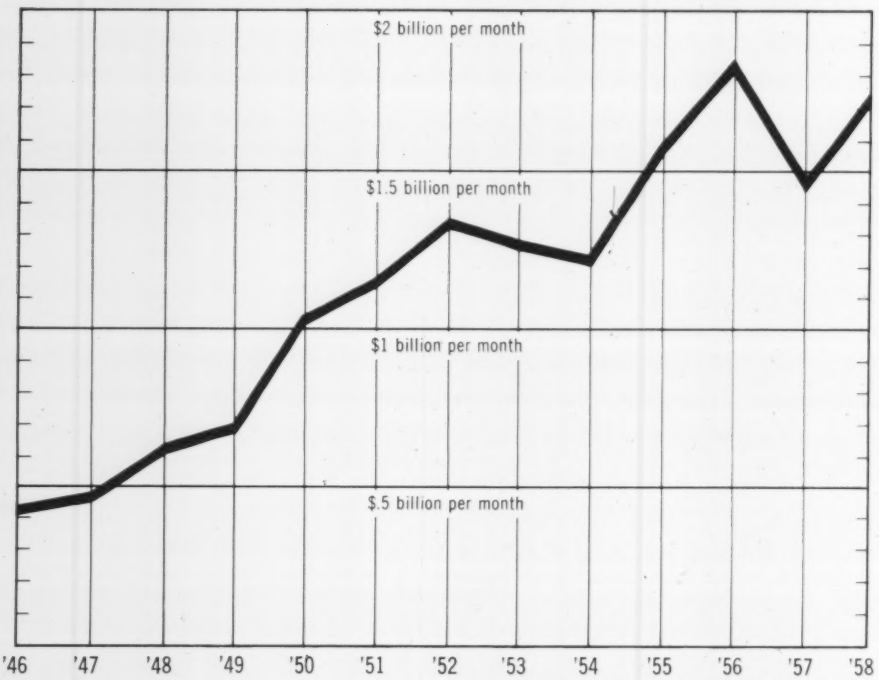
## CATERPILLAR RESEARCH AND DEVELOPMENT

A multi-million-dollar research and development program at Caterpillar Tractor Co. is paying off for you in the most productive earthmoving equipment ever manufactured. It's PROJECT PAYDIRT—the big news in the construction field today.

Caterpillar research consistently has been first with the major developments in earthmoving equipment. Each development has meant more production and more profit for owners of Caterpillar machines.

Since 1946 the money spent on heavy construction

GROWTH IN U. S. HEAVY ENGINEERING CONSTRUCTION




Source: *U. S. Dept. of Commerce*

SHARP INCREASE of money spent in U. S. on heavy engineering construction, both public and private, is shown in this graph. In 1946, a monthly average of $431 million in heavy engineering construction contracts was let. In the first eight months of 1958, contracts averaged nearly $2 billion ($1,717 million). By 1975, average monthly contracts of approximately $3.5 billion are expected.

## HERE'S WHAT *PROJECT PAYDIRT* MEANS TO YOU!

As the amount of construction increases, more contractors will enter the field, and competition for the work will be intense. Machines may be the difference between profit and loss. There will be no place for anything but modern, heavy-duty machines—machines that can perform *profitably*, day in and day out, under severe conditions.

Caterpillar has these machines, a full line of quality, job-tested earthmoving equipment. And PROJECT PAYDIRT insures that the Caterpillar line will always be ready for the job ahead, regardless of changing conditions and demands. Proof of this lies in the past record.

Since the end of World War II the Caterpillar line has experienced a continuous growth. And in 1951 the DW20 and DW21 were introduced. These wheel-type tractors soon proved ideal power units for scrapers. Also from PROJECT PAYDIRT that year: the No. 90 Scraper, top producer with track-type tractors; and the HT4, a track-type, hydraulic front end loader.

The workhorse D8 Pusher, designed especially for push-loading applications, was introduced in 1953, along with

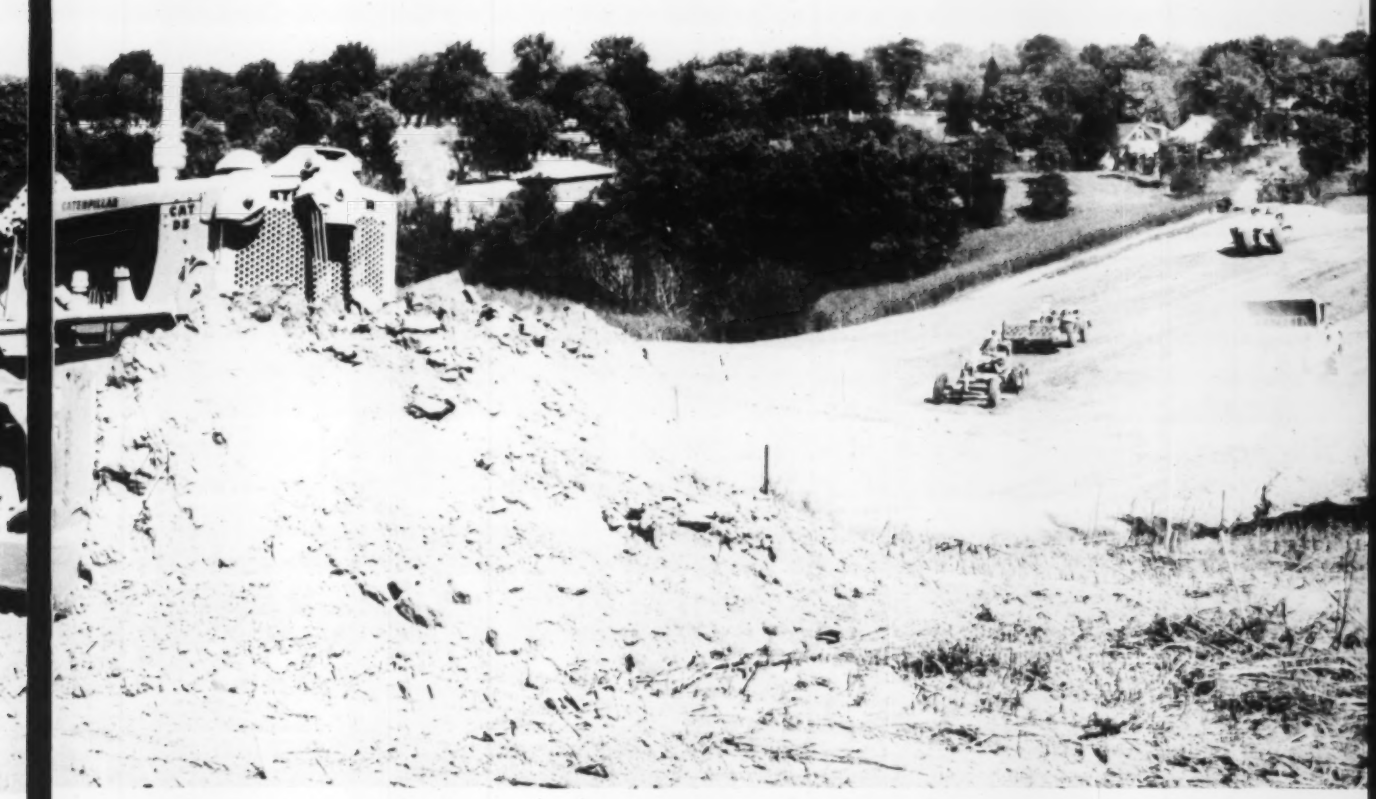
# Paydirt

## PACE GROWTH IN HEAVY CONSTRUCTION

in the United States has more than doubled. By 1975, experts predict, it will more than double again. Between now and then may well lie the country's greatest era of construction.

PROJECT PAYDIRT is Caterpillar's answer to the challenge of this explosive growth in heavy construction.

Money spent on heavy construction in U. S. has risen since 1946 from $5,172,000,000 to more than $20 billion. Experts predict that by 1975 annual expenditures will rise to more than $40 billion.




the No. 6 Shovel and the DW15, a smaller four-wheel tractor. 1955 brought the massive D9, king of the crawlers, equally effective as a bulldozer or for pushloading scrapers.

Also in 1955 came the three Traxcavators (Nos. 977, 955, 933), and the LOWBOWL Scrapers (Nos. 470, 456, 463), top producers that competitors still are trying to duplicate.

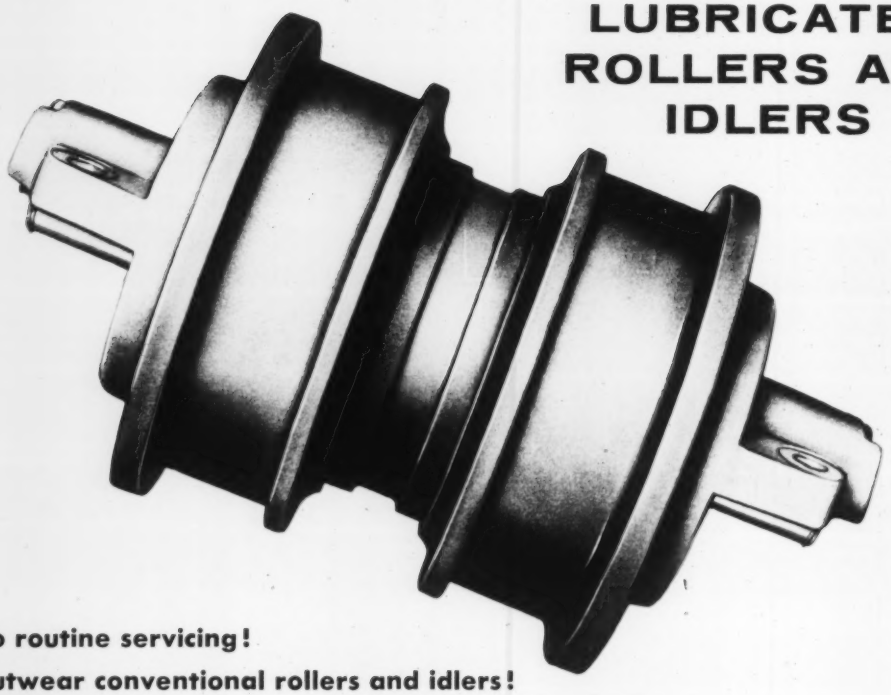
The Oil Clutch began setting new long-life standards in 1955. Also introduced in that year were other LOWBOWL Scrapers (Nos. 428, 435, 491), and tractor-mounted hydraulic Rippers (Nos. 4, 6, 8, 9).

In 1957, the Side Dump Bucket was offered as an attachment for the No. 955 Traxcavator, resulting in greater production through in-line loading. In the bulldozer line, the revolutionary Gyrodozer for the D7 Tractor began its career as the most versatile blade yet developed. PROJECT PAYDIRT was producing the equipment to match the growth in engineering construction.

The new Dry-Type Air Cleaner for the D9, DW20 and DW21 was introduced last month. This air cleaner removes 99.8% of all dirt in the intake air. And it requires only 5 minutes instead of the 20 formerly required to service the oil-type cleaner. That's 15 minutes more production time at each service period.

AND NOW CATERPILLAR'S PROJECT PAYDIRT BRINGS YOU...

# LIFETIME LUBRICATED ROLLERS AND IDLERS



- **No routine servicing!**
- **Outwear conventional rollers and idlers!**
- **Feature new leakproof seals that can be re-used!**

Three million test hours under the toughest conditions prove this fact: new D9 lifetime lubricated rollers and idlers have no equals for low-cost, trouble-free performance.

Lubricated in the factory, they never need servicing again until they are rebuilt. They last far longer with less maintenance than conventional counterparts. Their new seals are leakproof and can be used again and again.

These outstanding advantages are the direct result of Caterpillar's new, exclusive concept in roller seal design—a metal to metal, floating ring seal.

Important as the new seal is, it is only one of many major improvements in the new D9 track roller. Major changes have also been made in rim, hub, bushing, outer sleeve bearing, roller shaft, end collars and lubrication system. These advances greatly extend roller life and effect substantial savings when rebuilding is necessary. See your Caterpillar Dealer today. He has the full story on what the new lifetime lubricated roller can mean to you.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

**CATERPILLAR**

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

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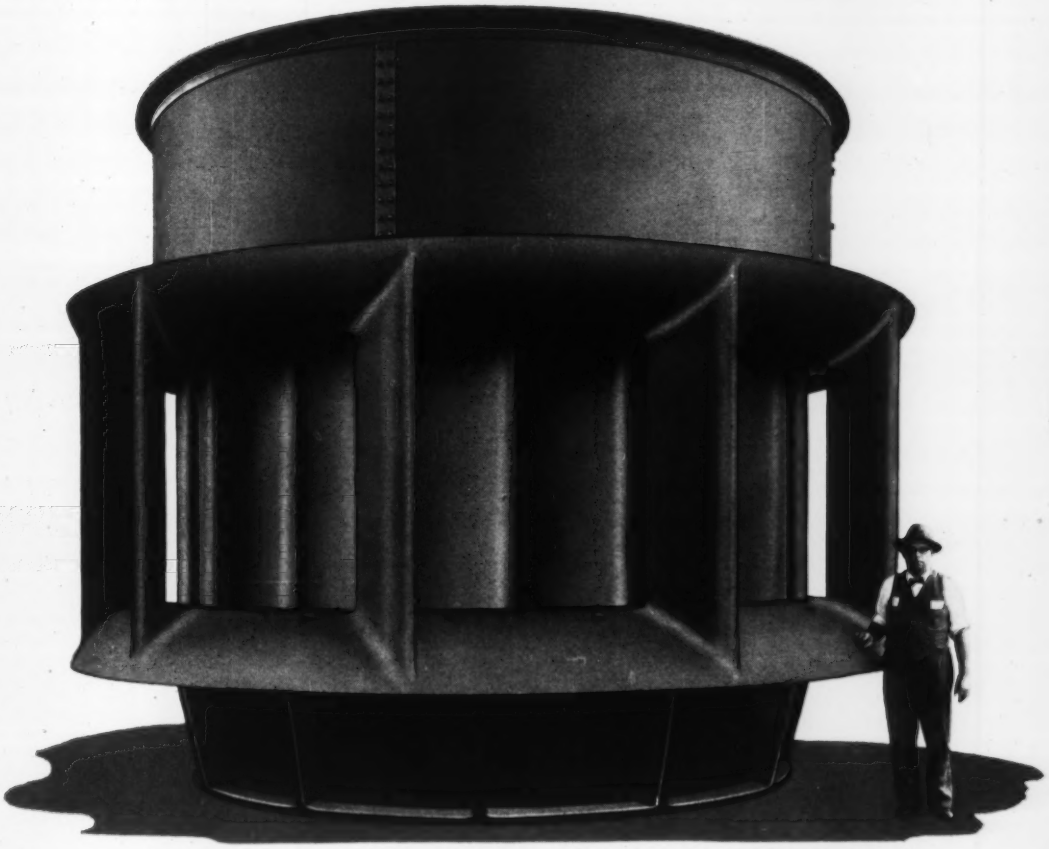
# A LEFFEL TURBINE IS A TITAN OF QUALITY



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Leffel's experience is derived from almost a hundred years of designing and building turbines of all types. The records show that many Leffel turbines have developed efficient, low cost, trouble-free power for more than half a century.

Leffel produces all types and capacities of hydraulic turbines for a range of heads from 3 feet to over 1,000 feet. And Leffel engineers are available to assist you, at all times, from the original planning of your project through to the actual installation of the turbine equipment.

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PROGRESS

# REPORT FROM ILLINOIS

As the national road building program gains momentum, reports from Illinois show the tremendous strides being made in this vast construction undertaking. Great toll roads and expressways are fast taking shape . . . linking the industrial might of Chicago and the great agricultural regions of southern Illinois with the super roads of neighboring states.

Reinforced concrete is playing a vital role in this multibillion dollar program. Throughout the length and breadth of Illinois, highway authorities are finding that their bridge and grade separation structures are being completed on schedule when they design in reinforced concrete.

## Bridge and Highway Construction Goes Full Speed Ahead on Schedule with Reinforced Concrete

Photographs courtesy of Department of Highways of the County of Cook, Illinois, and the Division of Highways, State of Illinois.

Workmen pouring concrete on steel reinforcing bars—Torrence Avenue Bridge spanning three sets of railroad tracks in Chicago, Illinois.

Workmen placing reinforcing bars in floor slab of Little Muddy Creek Bridge near Clay City, Illinois.

Reinforced concrete deck girder grade separation at 130th Street over Doty Avenue, Chicago, Illinois.

One of the outstanding applications of steel reinforcing bars in Illinois is this experimental, continuously reinforced concrete pavement which was constructed on U. S. Route 40 near Vandalia, Illinois.

CONCRETE REINFORCING STEEL INSTITUTE C.R.S.I. FOUNDED 1924

*Concrete Reinforcing Steel Institute*
*38 South Dearborn Street, Chicago 3, Illinois*

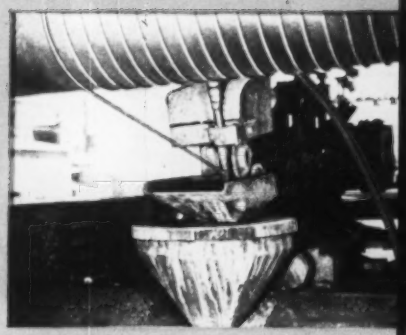
# improving a superior product

American Concrete Cylinder Pipe has long been established as one of the outstanding developments in the field of pressure transmission of water. This superior design combines the physical properties of steel with the structural and protective properties of concrete — producing a pipe of great strength and long life. Important transmission lines of American Concrete Cylinder Pipe are today serving most of the major cities and population centers in the western United States.

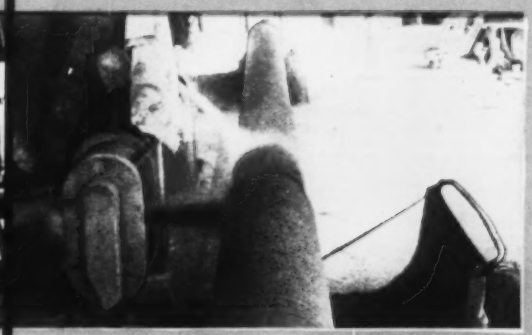
Through the years, continuing research has led to improved features in the manufacturing process. These features enrich the alkaline environment surrounding the steel components, which environment is so necessary to the continuing and everlasting protection that well-made concrete gives to this high quality pressure pipe.

Specify these plus-factors featured by American — where research, development and quality control are always striving to make high quality products even better.

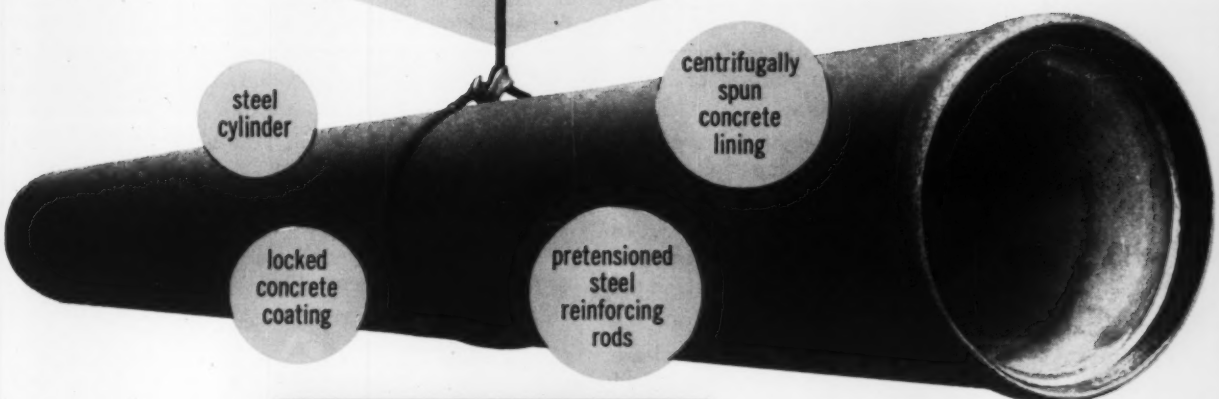
*American Concrete Cylinder Pipe is available in a diameter range of 12" through 60" I.D. and in standard lengths of 32 feet.*



Rich cement wash applied to steel reinforcing rod just before it is wound under measured tension and with accurate spacing around concrete lined cylinder provides positive assurance of a highly alkaline environment between surfaces of cylinder and circumferential reinforcement.



An additional rich cement wash over the entire outer surface of the pretensioned steel cylinder before application of the pipe's dense mortar coating assures maximum alkaline environment where it is most needed.

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3. **New print pick-off** . . . prevents tearing, sticking or scratching.
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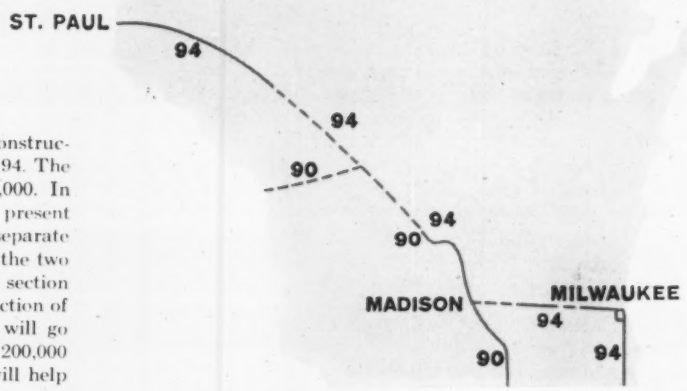
# Wisconsin Highway Program moves steadily forward

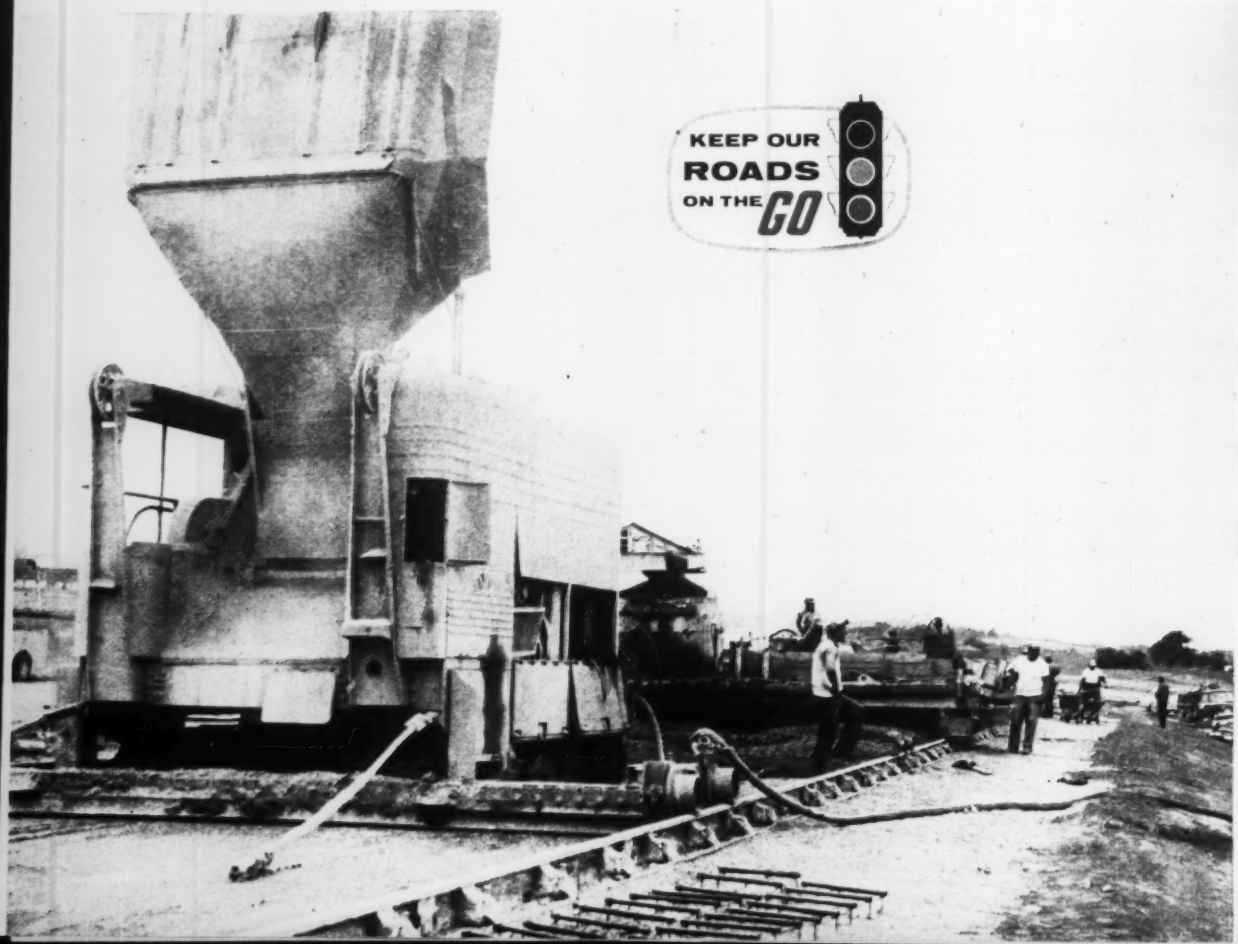
Almost 80-million dollars were budgeted in 1958 for work on Wisconsin's Interstate Highway Program. Construction is under way in eight counties on 72 miles of the proposed 452-mile system. In Waukesha County 7.3 miles are completed and in service. It is expected that the fall of 1959 will see the opening of new roadways in Rock, Dunn, St. Croix, Racine and Kenosha Counties. And work is progressing on the Milwaukee County Expressway System, parts of which will be incorporated into the Interstate Highway Program. Contracts now let for highway construction in eight counties total more than $33,000,000. General routing of Wisconsin's Interstate roadway has been approved in four other counties, and routes are being studied to complete the project in an additional four counties. The Federal government has allotted better than $26,000,000 for the Wisconsin Interstate system in 1960 and $20,000,000 for construction of the state's primary and secondary roads and for urban highways. The road building program is under the direction of Harold L. Plummer, Chairman, State Highway Commission and E. L. Roettiger, State Highway Engineer.

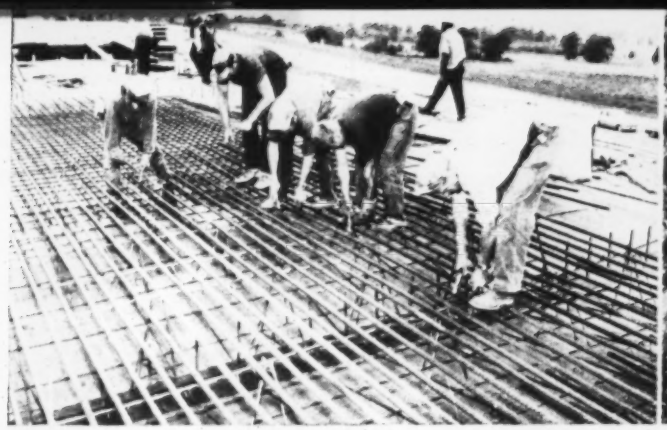
# Products of United States Steel keep Wisconsin's highways on the go!




The Wisconsin Interstate Program involves the construction of completely new roadways, Routes 90 and 94. The 452-mile system will cost upwards of $469,000,000. In southeast Wisconsin, Route 94 will parallel present Route 41 and for many miles will consist of four separate roadways, the outer two serving local traffic and the two inner roads being the expressway. The southern section of Route 90 will take traffic from Beloit to the junction of Route 94 at Madison. Farther north, Route 90 will go west from Tomah to connect with La Crosse. Over 200,000 tons of steel, most of it unseen by the traveler, will help make this a smoother, safer road system.

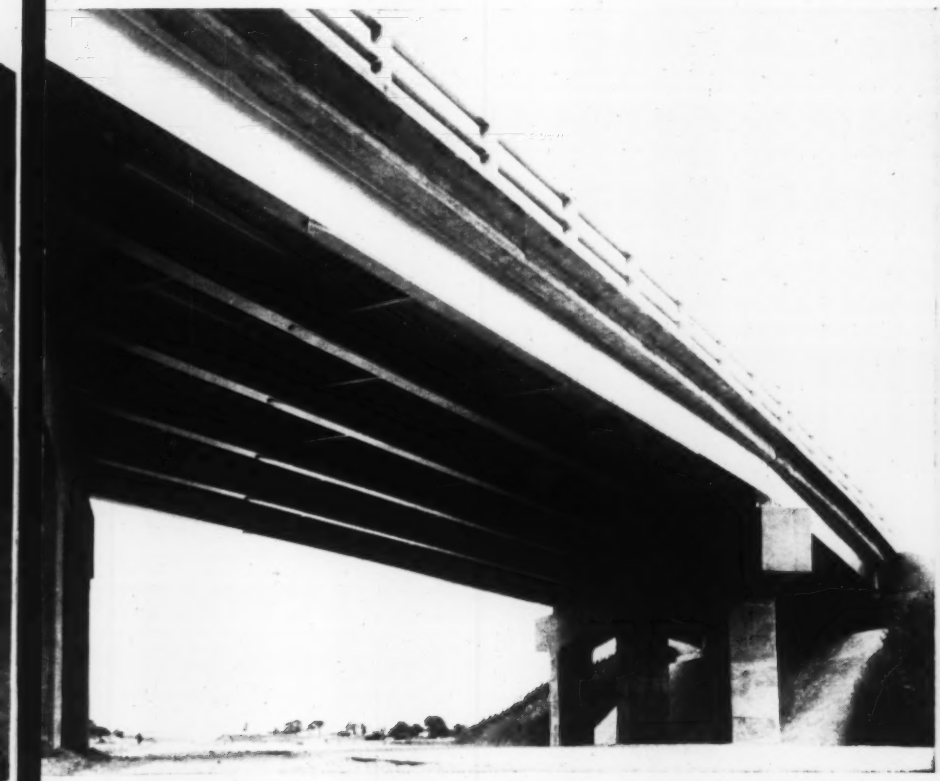
**Steel lays the foundation.** Before the paving machines started to pour concrete, four and a half million dollars worth of grading and hauling equipment went to work in Wisconsin's southeastern counties to meet the time and cost limits set for the job. USS High Strength Steels and USS *"T-1"* Constructional Alloy Steel have saved the owners of such equipment uncounted hours of costly delay by providing the strength and durability which keep abrasive wear to a minimum and eliminate maintenance stops. In hoists, derricks and paving machines, USS *American Tiger Brand* Wire Rope helps to assure full operating capacity under the toughest going.





**USS** *Di-Lok* **Reinforcing Bars** have a continuous diamond-locking deformation which assures positive anchorage to the concrete, reduces cracking to a minimum and makes shorter splices possible. On bridges, elevated expressways and overpasses, these bars add years of serviceable life to the roadway. Universal Atlas Cement Division of United States Steel provides *Atlas Duraplastic* air-entraining portland cement which makes a workable, plastic, extremely cohesive concrete that is fortified against freezing-thawing weather, prevents scaling caused by de-icing salts. *Universal* regular and air-entraining portland slag cement, *Atlas* regular and air-entraining high-early cement, and *Universal* and *Atlas* portland cements are also available to meet every paving need.

**The construction of large drainage** structures can be a quick, easy job when USS *AmBridge* Sectional Plate is used. These low-maintenance structures can be provided in Pipe, Pipe-Arch and Arch sections in a wide range of sizes and gages. For smaller drainage systems, corrugated metal drainage products made of USS Culvert Sheets are recommended for strength, low cost and speed of installation. To provide safety on bridges and curving ramps, USS guardrails or galvanized highway guard cable can be installed quickly and inexpensively.



**We will be glad** to send you a free copy of this 54-page catalog which is crammed with information about USS Steel Products that can help cut work and costs, and speed up all phases of highway construction. It lists all services as well as products available from United States Steel. Write to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

**Fifteen interchange and stream bridges** have been erected in the seven-mile stretch of Route 94 now completed in Waukesha County. USS H-Beam Bearing Piles for pier and bridge foundations are available in a range of sizes to accommodate all desired design loads. Their compact shape permits easy driving to desired penetrations even in difficult soils. Bridges and overpasses can be made lighter, stronger and longer lasting with USS *Tri-Ten* and the other brands of USS High Strength Steel, USS *Cor-Ten* and USS *Man-Ten*. Thinner and lighter sections frequently lower the cost substantially.

*USS and trademarks in italics are registered by U. S. Steel*

United States Steel

USS

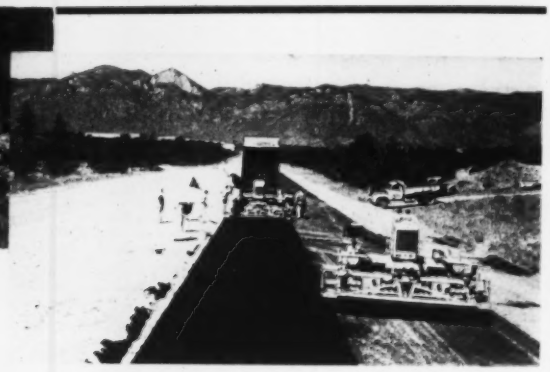
**Divisions of United States Steel serving the highway market:** American Bridge Division, Pittsburgh, Pa. • American Steel & Wire Division and Cyclone Fence Department, Cleveland, Ohio Columbia-Geneva Steel Division, San Francisco, Calif. • Consolidated Western Steel Division, Los Angeles, Calif. • National Tube Division, Pittsburgh, Pa. • Tennessee Coal & Iron Division, Fairfield, Alabama • Universal Atlas Cement Division New York • United States Steel Supply Division, Steel Service Centers, Chicago, Illinois

(Photo by Stewart's for Exchange National Bank)

View of Air Force Academy from a helicopter. Main buildings of Academy in background, at foot of Rampart Range of the Rockies.

# U. S. Air Force Academy

COLORADO SPRINGS, COLO.



Although it is interested primarily in air transport our new Air Force Academy could not function efficiently without its network of more than 50 miles of 4-lane and 2-lane roads.

The wearing surface, base and subbase constructed on these roads provide a pavement which is flexible from top to bottom. It consists of a 6-inch gravel subbase, covered by a 4-inch crushed stone base. After the base is primed with a medium-curing Texaco Cutback Asphalt, it is topped by a wearing surface of resilient, rugged Texaco Asphaltic Concrete 2 to 2½ inches thick.

Thanks to the flexible character of this type of pavement, it maintains complete contact with the supporting subsoil at all times. This is why flexible paving is able to withstand heavy traffic longer than rigid paving and at a lower upkeep cost.

Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils offer the road builder a wide choice of pavement types. These range from heavy-duty paving for Interstate Highways to inexpensive asphalt surface-treatments for suburban residential streets. Helpful information on all types of asphalt construction for roads, streets, airports and parking areas is supplied in two free booklets. Write our nearest office for copies.

**Its network of roads is paved with durable Texaco Asphaltic Concrete**

CONTRACTOR—Peter Kiewit Sons' Company, Denver, Colo.

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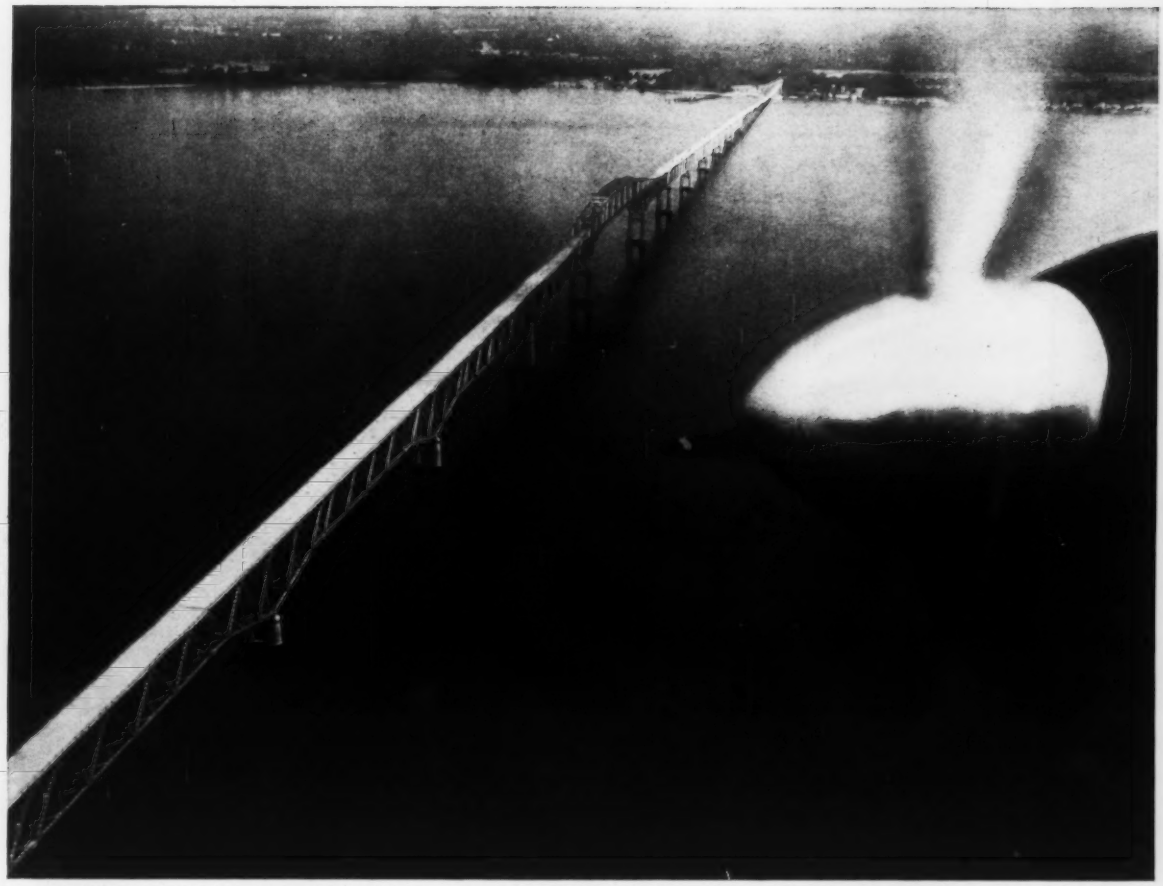
TEXACO

# TEXACO ASPHALT



Another major bridge joins the growing list of bridges large and small built for lasting economy with bearing plates of Lukens stainless-clad steel.

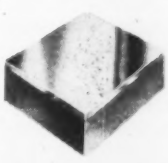
# In The New Rappahannock River Bridge

## LUKENS CLAD STEEL BEARING PLATES SAFEGUARD SOUND ENGINEERING

Bridge bearing plates of Lukens stainless-clad steel provide the corrosion protection of stainless—economically. Maintenance costs are reduced to a minimum. The free movement so essential to bridge safety is assured. In addition to the Rappahannock, other major bridges employing Lukens bearing plates include the Walt Whitman Bridge, the Greater New Orleans Mississippi River Bridge, and the Throgs Neck Bridge now being built.

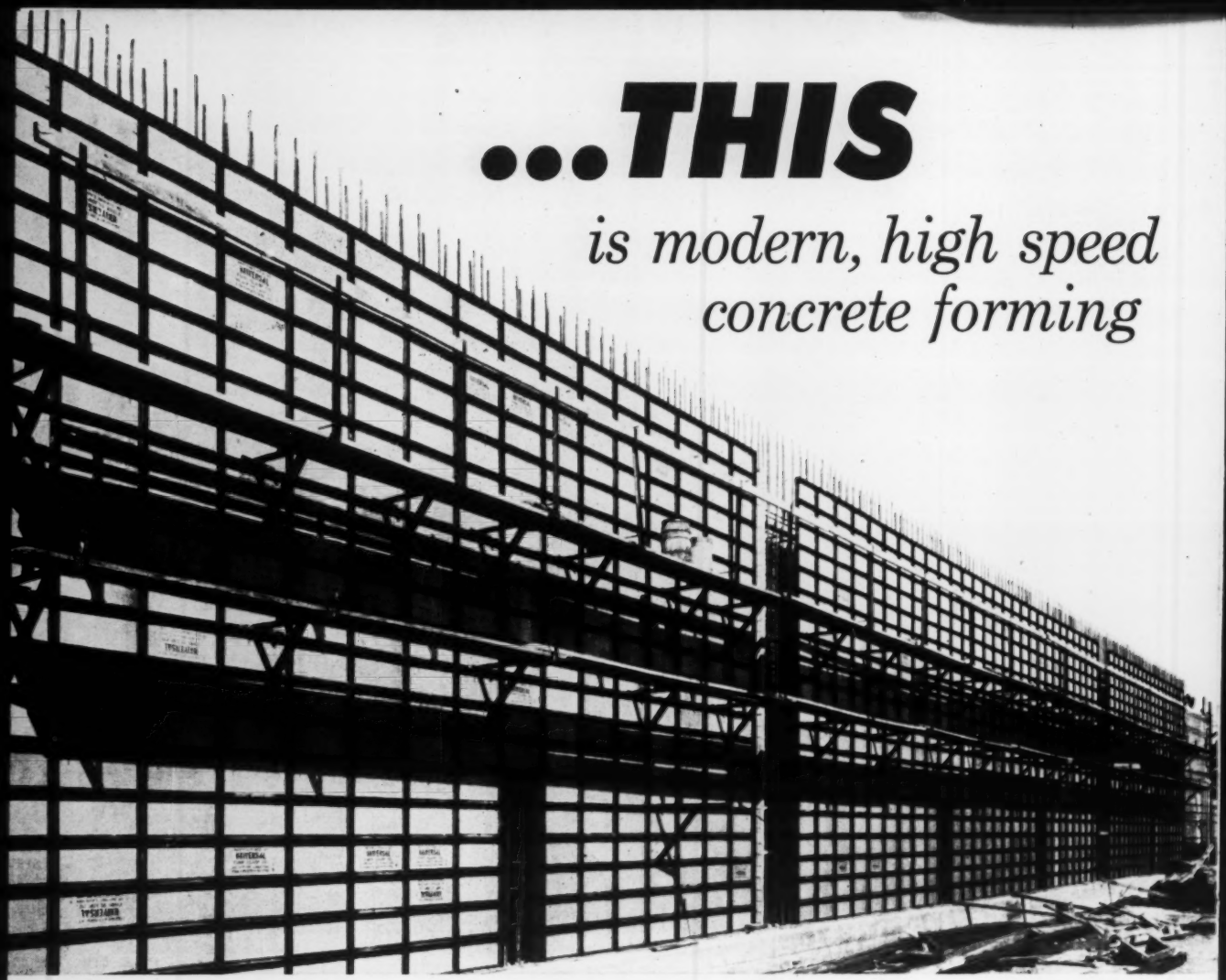
To meet varying design demands, particularly with regard to strength, there are two types of Lukens clad steel bearing plates. The standard type provides a minimum yield strength of 30,000 psi. A higher strength plate—incorporating A-302, Grade B backing steel for use in larger bridges—will meet a 50,000 psi. minimum yield strength requirement. And all bearing plates can be supplied flattened and machined on both sides to within .010 inch of dead flat.

**For details,** write—Manager, Marketing Service, 164 Lukens Building, Lukens Steel Company, Coatesville, Pa. Ask for special bulletin 180.



**LUKENS clad steel** is a solid plate—one surface corrosion-resistant metal permanently bonded over all to an economical backing steel.

LUKENS



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## *is modern, high speed concrete forming*

THIS IS UNI-FORMING... THE FASTEST GROUND-TO-GROUND SYSTEM

of concrete forming capable of handling virtually any type of poured concrete structure. UNI-FORMING is faster because assembly of UNI-FORM Panels with UNI-FORM Ties and Tie Keys is a simple mechanical (and automatically accurate) process . . . faster because minimum alignment and bracing is required on 1 side only . . . faster because every forming requirement is engineered into the system. In addition to its speed you'll find that the UNI-FORM System of concrete forming has many other advantages you can use to save time, money and labor.

**UNI-FORMING HAS 3 BASIC ELEMENTS**

**1.**

**The UNI-FORM Panel is plywood faced, steel framed to provide strength and rigidity plus all the advantages of a nailing surface. Made in standard heights from 1 ft. to 8 ft.; widths 2 ft., 18".**

**2.**

**UNI-FORM Ties lock and spread UNI-FORM Panels. Made for all wall sizes. Special ties available.**

**3.**

**UNI-FORM Tie Keys securely lock Panels and Ties together.**

***Want more information on the UNI-FORM System? Write for new full line catalog today.***

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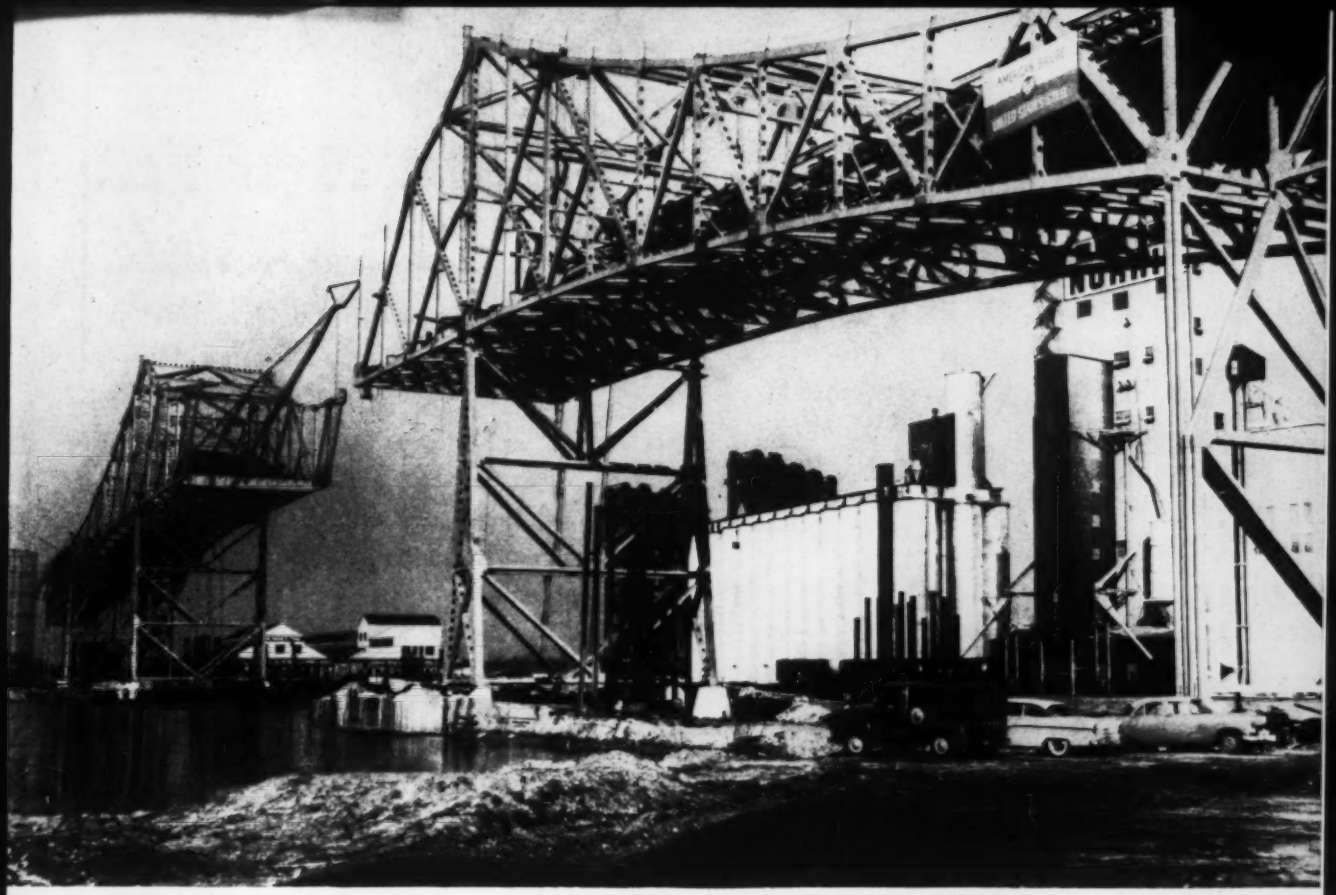

**Contractor:** City of Chicago, Illinois and American Bridge. **Owner:** City of Chicago, Illinois. **Designs by:** J. E. Greiner Company, Baltimore (Section Engineers) and DeLeuw, Cather & Company, Chicago (Coordinating Engineers).

## Calumet Skyway Toll Bridge—
## new link in Chicago's Expanding Expressway Program

**This important new bridge,** fabricated and erected by American Bridge, carries Skyway traffic across the Calumet River in Chicago, Illinois. It represents another step forward in Chicago's dynamic program of public improvements. The new six-lane toll bridge is 2,467 feet long and has a 125-foot vertical clearance above water at the center of the main span.

For the erection of this bridge, American Bridge fabricated and erected 8,673 tons of structural steel. This total included 977 tons of USS MAN-TEN High Strength Steel and 2,649 tons of USS COR-TEN High Strength Low Alloy Steel. American Bridge also supplied 912 tons of reinforcing steel, 3,872 lineal feet of wrought-iron and cast-iron drain pipe, plus flooring, railing and other auxiliary items. American Bridge fabricated and erected an additional 13,517 tons of structural steel on other sections of this important new traffic artery.

American Bridge has the experience, manpower and facilities to handle vital jobs like this as part of every-day operations. Put our "know-how" to work on your next project.

*USS, Man-Ten and Cor-Ten are registered trademarks*

**CONSTRUCTION DETAILS:**

**Spans:** One 1,300-foot thru cantilever truss composed of one 650-foot center span and two 325-foot anchor spans. Three 208-foot truss spans. Three 178-foot deck truss spans.

**Supports:** Four steel towers. Six steel bents.

**Roadways:** Two 36 feet wide. One 4-foot-wide median strip.

**Trusses:** 95 feet deep at main tower. 50 feet deep at center of main span. 32 feet 4 inches deep at shore ends of anchor spans. 28 feet deep at approach deck spans. 87 feet center to center of cantilever trusses.

**Field connection:** Riveted.

**American Bridge**
**Division of USS United States Steel**

General Offices: 525 William Penn Place, Pittsburgh, Pa. Contracting Offices in: Ambridge · Atlanta · Baltimore · Birmingham Boston · Chicago · Cincinnati · Cleveland · Dallas · Denver · Detroit · Elmira · Gary · Houston · Los Angeles · Memphis · Minneapolis · New York Orange, Texas · Philadelphia · Pittsburgh · Portland, Ore. · Roanoke · St. Louis · San Francisco · Trenton · United States Steel Export Company, New York

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Lay Tyton Joint® pipe and relax.

Tyton Joint pipe is sealed tight...water-tight ...by a specially designed rubber gasket that is compressed by the entering pipe.

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tighten. What's more, you can lay Tyton Joint pipe in rain or wet trench if need be. Result? More working days... fewer delays... time and money saved in the trench.

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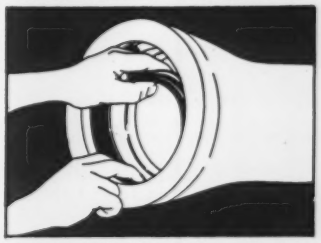
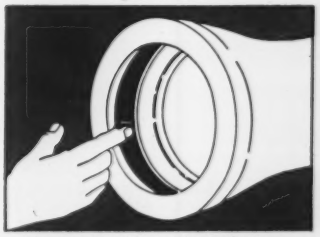
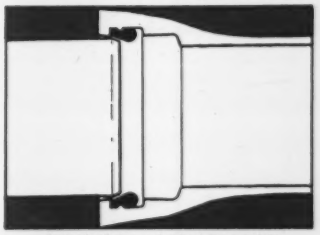


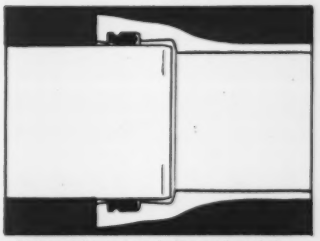
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket... the job's done!

8" Tyton Joint water line for new high school in Alabama.

# NEWS OF ENGINEERS

**Thomas F. Spencer,** Lieutenant Colonel, U.S. Army Engineers, has been assigned to duty with the Corps of Engineers' Eastern Ocean District. He will be area engineer in the District office in Keflavik, Iceland. Until his new assignment Colonel Spencer served as commanding officer of the 79th Engineer Group at Ft. Belvoir, Va.

**Charles M. Spooner, Jr.,** and **E. C. Driver** announce the formation of a consulting firm, Driver and Spooner. The firm, which is located in Coral Gables, Fla., offers general professional engineering services. Mr. Spooner was formerly with the Walsh Construction Company in Miami.

**William J. Wallace,** engineer of streets with the City of Detroit Department of Public Works, is retiring after 44 years of service. During his stay with the city, Mr. Wallace was in responsible charge of plans, specifications, and contracts for 1,400 of the 2,200 miles of street paving in Detroit. In 1927, he was in charge of the design and construction of the City Airport and also set up the operating and maintenance system.

**S. O. Asplund** has joined the faculty of the University of Florida as a visiting lecturer in the civil engineering department. Dr. Asplund, who is a professor of structural mechanics at Chalmers University in Gothenburg, Sweden, presented a paper on "The Design, Construction and Performance of Short Flexible Suspension Bridges for Heavy Trucks" at the recent Annual Convention. Dr. Asplund is a frequent visitor to the United States, and for some years was with the American Bridge Company on design work.

S. O. Asplund

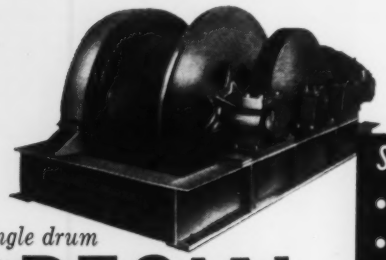
**Russell C. Brinker** has joined the staff of Texas Western College as professor of civil engineering. Professor Brinker, a retired Rear Admiral in the Civil Engineer Corps of the U. S. Naval Reserve, was formerly editorial director of engineering books for the Ronald Press Co. For some years he taught at Virginia Polytechnic Institute.

**Albert E. Stoltz,** Colonel, Army Air Force, will retire at the end of December as director of the Air Force Academy Construction Agency after serving in the post since 1955. Colonel Stoltz will join Skyway Park, Inc., and Vicon, Inc., of Colorado Springs, Colo., as engineer and planning and projects manager. Colonel Stoltz has been in military service for over 25 years.

**Cedric Willson** will head the newly formed sales engineering department of Texas Industries, Inc., in Fort Worth. Mr. Willson, who has been with Texas Industries for several years, is vice-president in charge of engineering. **Harold F. McDonald** will be an assistant in the department. He goes to the company from the Texcrete Structure Products Company where he was a sales engineer.

**J. H. Fenton** has retired as district manager of the Baltimore district of the American Bitumuls and Asphalt Company. Mr. Fenton has spent 38 years with the company, serving in a number of responsible positions.

*(Continued on page 36)*

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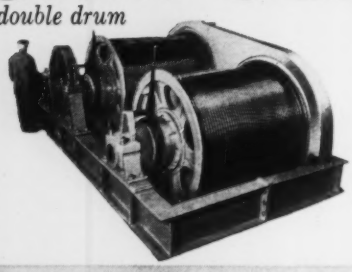
- *speed*
- *special conditions*

*double drum*



*For your Special Carpuller consult Superior-Lidgerwood-Mundy—They Know How.*

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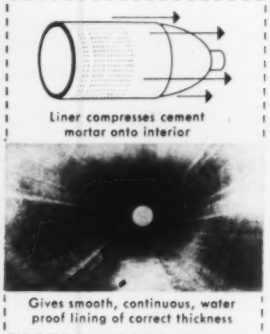


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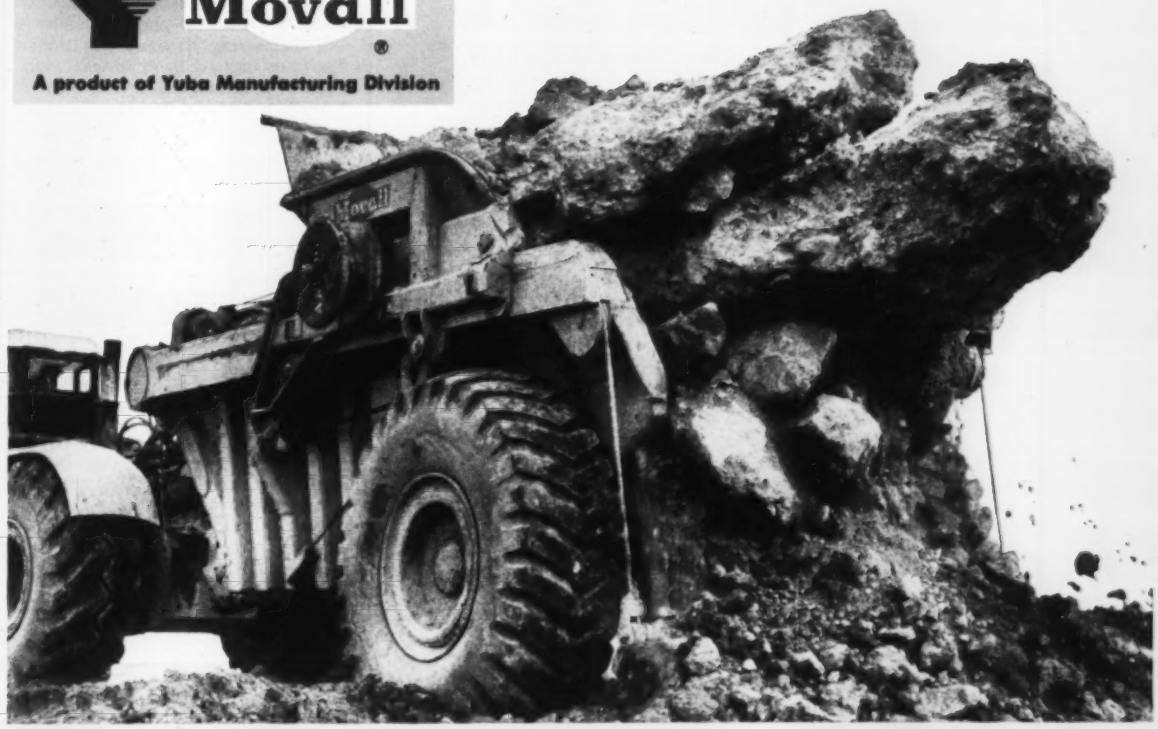

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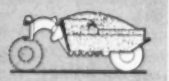
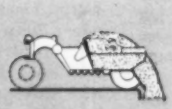
**EXCLUSIVE LEVEL-ACTION EJECTOR SAVES TIME AND MONEY**

**LOADED**—The big target, big capacity body carries its load low, maintaining high ground clearance since frame and body are integral and compact.



TAIL GATE UP

**DUMPING** — Level body offers no gravity resistance, with potential 140,000 lb. ejector push assuring complete positive discharge with minimum use of power.



TAIL GATE DOWN

**EMPTY** — Sides and bottom are scraped clean, eliminating need for "mucking out" or decreasing capacity for next full load. Complete ejection takes only 11 to 14 seconds.

TAIL GATE DOWN

## *140,000 pound push cleans out desk-size rocks or sticky clay—clean as a whistle in just 14 seconds!*

*The versatile, high-speed Yuba "Movall" outperforms rear and bottom-dump haulers on most every type of off-highway job!* Its powerful, positive ejector makes playthings of giant rock, frozen muck, or any other top loaded material. Bigger year 'round profits are yours with low-maintenance "Movalls" on the job. Check their unbeatable combination of features, such as high clearance, 180° turning radius, full stability in *all* operations, big tire flotation and traction, huge capacity. Get full information from your Allis-Chalmers, Caterpillar, or International Harvester Dealer, or contact *Yuba Manufacturing Division, Benicia, California,* today.

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**Yuba designs and builds a wide range of equipment for engineered construction:**

Sigunit makes air-applied mortar rapid-setting and water resistant. Sigunit is well suited for work on tunnel linings, sea walls and spillways as it adheres to damp and leaking concrete surfaces. Water and rising tides will not wash out or cause structural weakness at the waterline.

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## News of Engineers

(*Continued from page 34*)

**Benjamin B. Ewing** has accepted an appointment as associate professor of sanitary engineering at the University of Illinois. Before joining the faculty at the University of Illinois, he was on the staff of the University of California where he was studying for his doctorate.

**Marvin Schechter** recently joined the Society Headquarters staff as Assistant Editor of Technical Publications. Mr. Schechter was formerly a highway bridge designer in the Highway Bridge department of Parsons, Brinckerhoff, Hall & Macdonald in New York City. A 1956 graduate of the City College of New York, he is doing graduate work at Brooklyn Law School in the evening. While at C.C.N.Y., he was active in the Student Chapter, which he served as corresponding secretary.

**Marvin Schechter**

**Harold R. Shipman's** appointment as Chief of the Pan American Sanitary Bureau's Branch of Environmental Sanitation was announced recently. The PASB is the Regional Office for the Americas of the World Health Organization and offers advisory and consultant services to the governments of the Latin American countries on the education and training of sanitary engineers. Mr. Shipman is author of various publications on sanitary engineering.

**George Sydnor Robinson,** who has served the Navy since 1937, recently reported to the Norfolk Naval Shipyard in Virginia as the new public works officer. His last assignment was as technical adviser to the Bureau of Aeronautics. Captain Robinson, during his long service, has been decorated as Commander of the Order of Honor and Merit by the President of Haiti, named Chevalier of the Legion of Honor of the Republic of France and presented with the Cross of the Order by the French Government.

**G. S. Robinson**

**Armando Hernandez,** partner and managing director of A. Hernandez y Cia Ltda., Prefabricaciones Nicaraqua, of Managua, Nicaragua, has introduced the cellular method of constructing reinforced concrete structural floors to Costa Rica. The technique of utilizing standard precast concrete boxes for floors of multi-story buildings, devised by Cuellar, Serrano, Gomega y Cia Ltda., of Bogota, Colombia, will be available through Productos de Concreto Ltda., of San Jose, C. R.

**LeRoy A. Brothers** is the new dean of the College of Engineering at the Drexel Institute of Technology in Philadelphia, Pa. He was on the Drexel faculty from 1927 to 1945 as associate professor of civil engineering. Recently Dr. Brothers has been engaged in important work with the U. S. Strategic Bombing Survey Analysis Branch of the U. S. Air Force.

**Everett W. Fowler** has taken over new duties as chief engineer in charge of the Engineering Department of the National Board of Fire Underwriters. He has served the National Board since 1928 as a member of the engineering staff and most recently as director of the codes and standards division in charge of the preparation of the National Board's recommended Building and Fire Prevention Codes.

**H. C. Gee,** president of Gee & Jenson, consulting engineers of West Palm Beach, Fla., announces the opening of a new branch office of his firm in Dunedin, Fla. The firm also has offices in Cocoa and Fort Myers.

**Robert S. Green** has assumed the duties of associate dean of the College of Engineering at Ohio State University. Since 1954, Professor Caldwell has been executive director of the Engineering Experiment Station at the university. He will retain this position and will continue to serve as professor of welding engineering.

**R. S. Green**

Recent appointments to the Advisory Commission of the Construction Technology Department of New York City Community College included five ASCE members. They are: **Marcel P. Aillery,** chief structural engineer, J. G. White Corp.; **Henry O. Fraad,** underwriter-engineer; **John G. Hotchkiss,** district engineer, American Institute of Steel Construction; **James Ruderman,** consultant; and **Edward E. White,** executive vice-president, Spencer, White & Prentis, Inc.

**Frank L. Weaver** has recently been named by the International Joint Commission to membership on the International Passamaquoddy Engineering Board. Mr. Weaver is chief of the Division of River Basins, Bureau of Power, with the Federal Power Commission in Washington, D. C. He replaces **Francis L. Adams** on the Board. Mr. Adams has been appointed by President Eisenhower to the International Joint Commission. Mr. Adams holds the post of chief of the Bureau of Power with the FPC. **Lt. Gen. S. D. Sturgis** (retired), former Chief of Engineers, is the other member and chairman of the U. S. section of the Passamaquoddy Engineering Board.

**Howard Simpson** recently received a Doctor of Science in Civil Engineering from the Massachusetts Institute of Technology. A member of the consulting firm of Simpson, Gumpertz and Heger, Inc., Dr. Simpson was recently honored by the Boston Society Civil Engineers with the award of the Desmond Fitzgerald Medal for a paper on the new ACI Code. Dr. Simpson is an associate professor of structural engineering at M.I.T. It was incorrectly stated in the October issue that his degree was honorary.

**John Q. A. Greene** has retired as executive vice-president and secretary of the Gunite Concrete and Construction Co., Kansas City, Mo., after 36 years with the company. He will continue to serve as West Coast representative for the company with his office in Los Angeles.

**W. D. Painter** has become a partner in the consulting firm of Clark, Daily and Dietz. Dr. Painter, an associate in the firm since early 1957, will continue his duties as project engineer of its operations in the Memphis, Tenn., area. The firm has also taken two other ASCE members as associates—**M. Fuat Tigrak** and **Jamison Vawter.**

**Lester C. Rogers** and **Arthur W. Consoer** have been elected to serve as members of the National Council of Tau Beta Pi, honorary engineering fraternity. Mr. Rogers is president of the Bates & Rogers Construction Corporation in Chicago, and Mr. Consoer is managing partner of Consoer, Townsend and Associates, also of Chicago.

**Stephen D. Teetor** has accepted an appointment as chairman of the Engineers Division of the 53rd Annual Appeal of the Travelers Aid Society of New York. Mr. Teetor is a partner in the New York City consulting firm of Seelye, Stevenson, Value & Knecht.

**Robert L. Janes** has joined the staff of the Research and Development Division of the Portland Cement Association. He will be senior development engineer and will have his office in Skokie, Ill. He was formerly with the Armour Research Foundation as assistant manager of mechanical engineering research.

**Nelson Nemerow** has been appointed professor of civil engineering at Syracuse University. Professor Nemerow was formerly associate professor of sanitary engineering at North Carolina State College. He is chairman of the Sanitary Engineering Division's Committee on Sanitary Engineering Research.

**W. W. DeBerard,** city deputy water commissioner of Chicago, Ill., has been made treasurer emeritus of the Federation of Sewage and Industrial Wastes Associations. This honor was conferred upon Mr. DeBerard at a banquet of international water and sewage engineers. Mr. DeBerard, who is also chief city water engineer, served as editor of Engineering News-Record for 30 years. He is an Honorary Member of the Society.

(*Continued on page* 38)

**TREMENDOUS WORK POTENTIAL**

**T-2 UNIVERSAL THEODOLITE**

The Wild T-2 enables the operator to work rapidly, precisely and steadily under conditions that may range from equatorial to antarctic.

Optical and mechanical excellence, plus negligible maintenance requirements, combine with a complete list of accessories to make the T-2 the finest instrument in its class by far.

Write or phone for Booklet T-2 for complete data.

*Full Factory Services*

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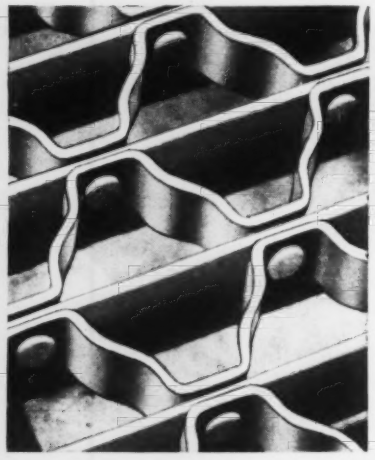
New "CK" BRIDGE DECKING ENDS WEAVING OF CARS



Modification of the original Irving Type V Decking has eliminated "weaving" on open mesh steel floors. The improvement is effected by a 3/16" elevation difference of the crimped bars over the straight bars.

"CK" Decking, successfully field-tested for 4 years, has the same advantages of safety, strength, durability and self-maintenance as standard Type V Decking

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*Originators of the Grating Industry*

Offices and Plants at
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## News of Engineers

(*Continued from page 37*)

**John A. Neale,** chief engineer of the National Board of Fire Underwriters, has retired from active practice after a long career in the engineering field. Mr. Neale started his career with the Fire Underwriters in 1924 with the Chicago Board of Underwriters. He has held his present post of chief engineer of the National Board since 1950.

**Robert F. McCune** has resigned as vice-president of the Place Ville Marie Corporation, a Webb & Knapp (Canada) venture, to become president of the Canadian American Associates, Ltd., management and engineering consultants. Mr. McCune will have his office at the corporation's headquarters in Montreal.

R. F. McCune

**Max J. Striedl,** honored as the 1958 C. C. Wiley Traveling Award in Highway Engineering at the University of Illinois, recently completed a 9,100-mile automobile trip which took him through 16 states. The award of $1,200 permits a senior student in highway engineering to study and report upon highway transportation problems in the states visited. Mr. Striedl is currently working on the Illinois Toll Road near Aurora for Vogt, Ivers, Seaman and Associates, consulting engineers, pending call to military service.

**J. P. Lawlor** has retired as president of the General Filter Company in Ames, Iowa. Mr. Lawlor founded the company in 1935 and has served as president since its founding. He has also held the office of mayor of Ames. Mr. and Mrs. Lawlor will spend the 1958-1959 winter touring South America.

J. P. Lawlor

**John W. Caldwell** has taken the position of area engineer with the Bureau of Public Roads in Nashville, Tenn. He was formerly employed as a highway engineer on location with the Georgia State Highway Department, with headquarters in Atlanta.

**Donald F. Dougherty** has been appointed district engineer of the Albany, N. Y., area of the Surface Water Branch of the U. S. Geological Survey. Mr. Dougherty was previously district engineer for the Survey at Trenton, N. J.

**Moreland Herrin** has been appointed associate professor of civil engineering at the University of Illinois. In this capacity, Dr. Herrin will be responsible for the teaching and research program relating to bituminous materials, mixes, and pavements. During the past summer he served as materials engineer in charge of the laboratory on the AASHO Road Test.

**John P. Merriam** has been appointed associate professor of irrigation at California Polytechnic College, San Luis Obispo, Calif. Before taking his new post, Professor Merriam spent two years in Saudi Arabia as senior irrigation engineer for the Division of Water Resources of the Ministry of Agriculture there.

**H. W. Van Loo** announces the formation of the new partnership of Coe and Van Loo with offices in Yuma and Wellton, Ariz. Mr. Van Loo was formerly project manager, Yuma Projects Office of the Bureau of Reclamation and most recently general manager of the Wellton-Mohawk Irrigation and Drainage District in Arizona.

**Thomas J. Scott** has been named vice-president of marine and heavy construction with the Maxon Corporation. Mr. Scott, who has been with Maxon since 1940, has been serving on the general staff in Dayton. Previously he had been assistant project manager. During World War II he was a Lieutenant Colonel in the Corps of Engineers.

T. J. Scott

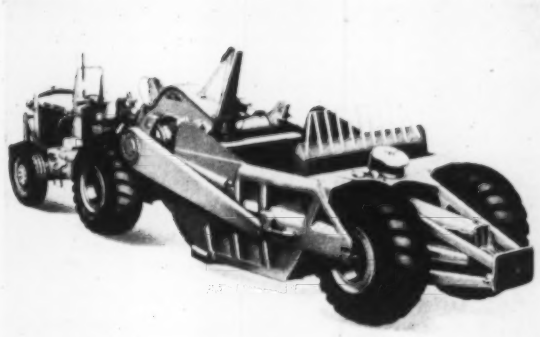
**H. K. Fairbanks** has been appointed consulting civil engineer for Ebasco Services, Inc., New York, N. Y. During his connection with Ebasco, Mr. Fairbanks has been project engineer on many hydroelectric and thermal electric generating stations. The company has named **H. W. Stuber** as chief concrete-hydraulic design engineer for the company. Mr. Stuber has been with Ebasco for 36 years, serving most recently as project engineer on hydroelectric projects abroad. **A. T. Larned** has taken the position of associate consultant in the consulting engineering division. He has been with Ebasco for over 40 years, specializing in the design of complete hydroelectric developments.

**Charles G. Holle,** Major General, U. S. Army Engineers, has retired from active service after 38 years of military duty. For the past three years, General Holle has been the top representative of the Chief of Engineers in construction of the St. Lawrence Seaway. He has also held responsibility in connection with the Lower Mississippi River and the Panama Canal.

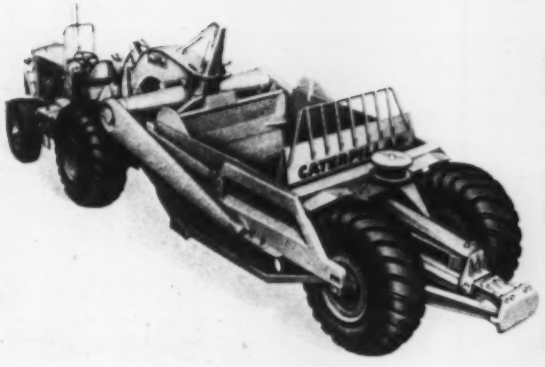
CATERPILLAR'S PROJECT PAYDIRT

**PROJECT PAYDIRT** pays off for you...

# NOW 2 SCRAPERS FOR THE DW20!



The new LOWBOWL
**NO. 482**
24 cu. yd. struck
34 cu. yd. heaped



The popular LOWBOWL
**NO. 456**
18 cu. yd. struck
25 cu. yd. heaped

To broaden the profitable uses of the high-speed DW20 four-wheel Tractor, Caterpillar now offers a big new LOWBOWL Scraper—the No. 482, rated at 24 cu. yd. struck, 34 cu. yd. heaped.

The popular No. 456, rated at 18 cu. yd. struck and 25 cu. yd. heaped, remains in the line. As a result, this provides you with a choice of two sizes of rugged, heavy-duty scrapers to better match the DW20 to the material and haul conditions on your job.

In short, here's where each scraper will fit best for maximum production at lowest cost per yard: The No. 482—in good loading conditions and haul roads of minimum grades and low rolling resistance. The No. 456—on adverse grades and average-to-high resistance haul road conditions.

In addition to the Cat No. 482 and No. 456 Scrapers, a complete Athey wagon line is available for use with the DW20. Whatever the job, you'll find the right earthmovers for it at your Caterpillar Dealer. See him today for complete facts about the big new No. 482.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

**PROJECT PAYDIRT:**
Caterpillar's multi-million-dollar research and development program—to meet the continuing challenge of the greatest construction era in history with the highest production earthmoving machines in the field.

## Additional facts about the No. 482

Like all developments of Caterpillar's PROJECT PAYDIRT, the No. 482 has been thoroughly tested in the field. Its high capacity offers the increased production essential to profitable performance on today's big jobs. It uses 33.5 x 33 (26-PR) tires. It is cable operated for fast, accurate control. Its three-piece "Spacesaver" draft frame can be disassembled to provide a shipping width of only 11′ 6″—three inches narrower than the No. 456. Its new bowl lift design and new push block arrangement increase loading and dumping efficiency. And its sturdy, simplified construction delivers many hours of trouble-free operation with minimum maintenance.

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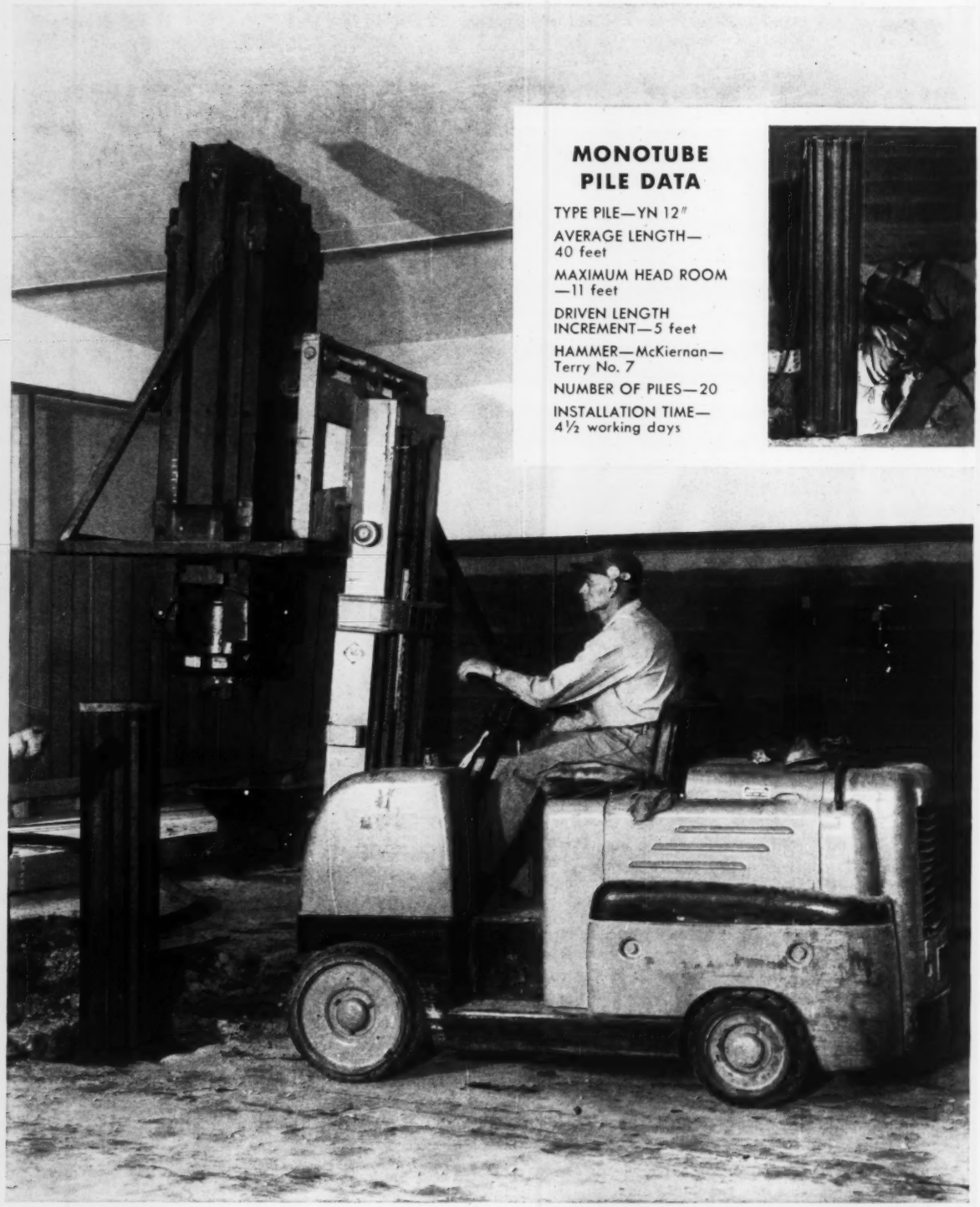

## MONOTUBE PILE DATA

TYPE PILE—YN 12″

AVERAGE LENGTH—40 feet

MAXIMUM HEAD ROOM—11 feet

DRIVEN LENGTH INCREMENT—5 feet

HAMMER—McKiernan—Terry No. 7

NUMBER OF PILES—20

INSTALLATION TIME—4½ working days



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# UNION METAL

*Monotube Foundation Piles*

# . . . . . Am-Soc Briefs

▶ ▶ Toward professional recognition. . . . At the October Convention the Board of Direction went on record as recommending that the chief executive officer in all public service departments where "there is major responsibility for engineering design" should be a registered professional engineer. . . . In similar vein was another recommendation urging that professional and scientific society affiliation be given weight in considering the suitability of applicants for public service jobs. "Recognition of such affiliation," said the Board resolution, "should be made a part of the qualification manual, guide or document used by an examining board, or like body, in the determination of professional competence in the engineering profession."

▶ ▶ Toward professional unity. . . . The Board has taken a positive step toward unity in the profession by urging the affiliation of the National Society of Professional Engineers with both Engineers Joint Council and the Engineers Council for Professional Development. It stated that ASCE would "view with high favor" the simultaneous affiliation of the NSPE with the two societies.

▶ ▶ Speaking of engineers in public posts. . . . M. J. Shelton heads the new ASCE Committee on Engineering in Public Practice. Frank L. Weaver is vice-chairman, and Wayne G. O'Harra, Board Contact Member. Other personnel are Charles H. Capen, Don M. Corbett, Simon W. Freese, Blucher A. Poole, John F. Tribble, and Graham P. Willoughby.

▶ ▶ Typical floor plans for the United Engineering Center are shown for the first time in "Society News". . . . As to the financing, member giving is one-third of the way to the goal with the campaign past the million-dollar mark. See the lead story in this issue for a joint message from our Past-Presidents on ASCE's role in the campaign.

▶ ▶ Manual 38—on the Private Practice of Civil Engineering for Engineers and Clients—is ready for distribution and may be ordered on the blank provided in the advertising section. A revision of old Manual 29, the new edition has raised fee curves to embrace projects up to $100 million. It also includes a valuable special section on fees for freeway work prepared at the request of Federal Highway Administrator Tallamy.

▶ ▶ No one who has ever attended a Society Convention in Los Angeles will be able to resist the lure of the 1959 Los Angeles Convention, set for the Statler-Hilton, February 8-13. Some of the highlights are previewed in the "Society News" section, and the complete program will be in the January issue.

▶ ▶ With apologies to all. . . . It was Leo Corning, chairman of the Structural Division, who represented ASCE on the steering committee for the First National Conference on Fundamental Research in Plain Concrete, and not Jackson Durkee and Josef Sorkin, as incorrectly stated on this page in the November issue. Messrs. Durkee and Sorkin arranged the program for the recent Conference on Electronic Computation in Kansas City.

# New Frontiers in Service

This emblem represents Vulcan Materials Company, one of the nation's major organizations serving the builders of America.

Vulcan Materials Company is a primary producer and marketer of such essential materials as ready-mixed concrete, aggregates - including slag, expanded slag, sand, stone and gravel - concrete pipe, prestressed concrete members, surfacing materials - including hot and cold mix bituminous mixtures and basic materials - metallics, chemicals and other construction materials.

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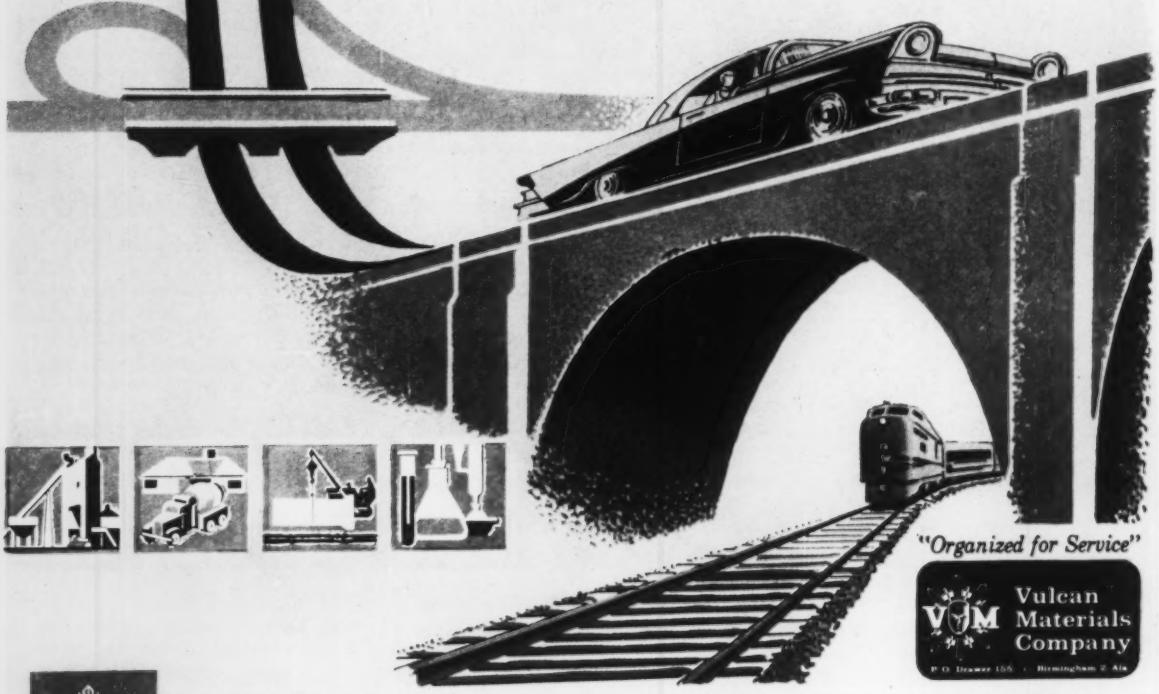
For service or for further information, call on any of Vulcan's divisions or sales offices. For the one nearest you, check the classified directory *or write* Vulcan Materials Company, P.O. Drawer 155, Birmingham 2, Ala.



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# do you know that

**Economists are optimistic about the 1959 business outlook?** The optimism is almost unanimous, according to the F. W. Dodge Corporation. In its twelfth annual poll of leading economists all but two of 212 participating expect that 1959 will be a good year, "substantially better than 1958," with the gross national product rising about 4½ percent to an annual rate of $460 billion. All but four think industrial production will show a similar trend. The government's consumer price index is expected to reach 125.5, compared with the current figure of 123.7. This year's outlook is in marked contrast to the forecast last year when the economists foresaw recession.

• • •

**Use of high-strength bolts instead of rivets for erecting steel structures is now accepted in every major American city?** Although bolting as a revived construction technique is less than five years old, all but two of the 25 largest cities in the United States have changed their building codes to permit the use of bolts. In the opinion of the Russell, Burdsall & Ward Bolt and Nut Company, pioneers in the development of high-strengths bolts, 75 percent of all steel structures are now joined with bolts.

• • •

**Enough water is lost every year by evaporation in the seventeen Western states to supply all the towns and cities of the country?** Each new study of the evaporation situation underscores its seriousness. Now the U. S. Geological Survey estimates that the 21,000,000 acre-ft lost annually by evaporation is more water than is being used by all the cities and communities served by public supplies in the entire nation.

• • •

**Czechoslovakia won the competition for the best pavilion at the Brussels Fair?** The Belgian civil engineering pavilion was second, and the British pavilion third. The United States and Germany tied for fourth place. The Soviet pavilion, incidentally, came out thirteenth.

• • •

**Salaries of state highway engineers have risen 16 percent in the past two years?** Even so, says the ARBA, salaries in most states are still lagging behind the minimums recommended by the American Association of State Highway Officials. These facts highlight the ARBA's fifth study of salary ranges for all grades of state highway engineers throughout the United States. Copies of the Survey are available from the American Road Builders' Association, World Center Building, Washington 6, D. C.

• • •

**Engineers Joint Council has a new member?** Acceptance of the South Carolina Society of Engineers as an affiliate member has been voted by the EJC board. This brings EJC's membership to a round twenty.

• • •

**The geographic center of the United States shifted 439 miles with the admission of Alaska to the union?** The new center of the country, according to the Coast and Geodetic Survey, is now in Butte County, South Dakota, 439 miles northwest of its former location near Lebanon, Kans.

• • •

**Atomic scientists see a possible solution to the problem of atomic waste disposal?** At the recent Geneva Conference on Peaceful Uses of Atomic Energy, the advantages of disposing of high-level radioactive wastes by solidifying were brought out. Glass was recommended as the most suitable solid with which fission products could be merged and stored. The use of this system would need only some 5 to 50 acres of disposal ground per year. The tank system of storage, it was agreed, is a stop-gap method, and it would be safer if liquid wastes could be converted into storable solids. In the United States alone 65,000,000 gal of liquid wastes are currently stored in tanks.

• • •

**California leads the states in estimated total of 1958 motor-vehicle registration?** With an expected 7,000,000 registrations, it will be well ahead of New York with about 5,000,000 registrations. Texas and Pennsylvania will each have over 4,000,000; Ohio, Illinois, and Michigan, over 3,000,000; and New Jersey and Florida, over 2,000,000. These nine states account for 51 percent of the total 1958 registration, which is estimated at 68,398,000. Arizona is leading in anticipated increase in total registration with 6.9 percent, followed closely by Florida with 6.8 and New Mexico with 6.4 percent.

# Causeway to the Future

## Galveston's New Pelican Island Causeway Features 3600 Feet of Prestressed Concrete Construction

PRESTRESSED CONCRETE VIADUCT, foreground above, leads over railroad switching yards to bridge and trestle on Galveston Ship Channel. (Left) Girder alignment on viaduct before concrete slab was cast in place.

● Back in 1867, most of the area now called Pelican Island, directly north of the City of Galveston, lay in one to five feet of water—according to charts prepared by the U. S. Coast and Geodetic Survey.

Today, shifting sands and dredged fill have made Pelican Island a valuable 4,000-acre site for industrial development. And years of civic planning and effort have created the magnificent new Pelican Island Causeway, linking this important property to the city.

The Causeway is approached from midtown Galveston over a 1522-ft. prestressed concrete viaduct, which crosses 17 railroad tracks in 50 to 100-ft. spans, providing direct vehicular access.

At the Galveston Ship Channel, a 2100-ft. prestressed concrete trestle connects with hydraulic fill embankments extending from both shores. In mid-channel, a 160-ft. rolling lift bascule span provides adequate clearance for all types of shipping.

This complete structure—requiring 50,000 barrels of Lone Star Cement—well illustrates the ever-growing use of prestressed concrete for bridges that are efficient and economical, both in initial cost and in ultimate cost over many generations of service.

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**GALVESTON COUNTY NAVIGATION DISTRICT NO. 1**

Engineers
**PARSONS, BRINCKERHOFF, HALL & MACDONALD**
New York, N. Y.

Contractors
**FARNSWORTH & CHAMBERS COMPANY, INC.**
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**TEXAS GULF CONSTRUCTION COMPANY, INC.**
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**KANSAS CITY BRIDGE COMPANY, INC.**
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LONE STAR CEMENTS COVER THE ENTIRE CONSTRUCTION FIELD

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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 21 MODERN MILLS, 48,900,000 BARRELS ANNUAL CAPACITY

Proposed United Engineering Center

# Let's get the job done

During the Annual Convention just passed, the undersigned Past Presidents of ASCE met in an inspirational and historic meeting. We believe it was the largest group of Past Presidents ever gathered together. Past President Hogan could not be present but asked that his name be subscribed to the message. Our concern was and is the financing and building of the United Engineering Center. We feel impelled to bring this message to the attention of every one of the 42,000 members of the Society.

We believe the construction of a United Engineering Center is an important step for the profession to take. Each of us has contributed. We ask each member to search his own conscience and then make a pledge commensurate with his faith and pride in the profession he has chosen for his life work and in keeping with the rewards the profession has accorded him.

Today the profession is engrossed with one of the greatest challenges it has ever had to meet—the raising of $3,000,000 in membership pledges to apply to the financing of an imposing United Engineering Center. The American Society of Civil Engineers traditionally has been the leader in activities significant to the progress and development of the engineering profession. ASCE must be the pace-setter in this campaign, in which its accepted quota is $800,000.

By early November the ASCE drive had netted only $170,000, giving little cause for gratification. On the credit side is the finding that the average pledge is $95, which is well above the average. But we are behind AIEE and ASME in total pledging; we are near the bottom among the Founder Societies in number of pledges; we are last in percentage of quota pledged. The American Society of Civil Engineers must reestablish its proud position of leadership despite the fact that we were late in reaching many of our members with a direct request for a pledge.

During the first ten months of the campaign 1,800, barely 4 percent, of our members made pledges. We do not believe this is the result of unwillingness to accept responsibility, nor professional apathy. We cannot believe that this is a failure to appreciate the morale-building and public-recognition benefits that will be derived from "a workshop for international technology" in a prestige location on United Nations Plaza.

It is our sincere conviction that *every* civil engineer should take part in the financing of the United Engineering Center. The annual income of the membership of the Society has been conservatively estimated at $350,000,000. The ASCE quota of $800,000, to be raised in three years, is less than one quarter of one percent of that *annual* figure. To meet that quota will not necessarily be easy, but it is certainly possible.

The United Engineering Center will be built. Two-thirds of the funds are on hand or pledged, and contributions are still pouring in from the industry and the membership drives. In the years ahead all those who have manifested their professional pride and loyalty by pledging their limit will find great satisfaction in the knowledge that they did so.

We urge *every* member to contribute now, spontaneously and with enthusiasm, toward this symbol of unity in the profession—toward this symbol of our contribution to the welfare of mankind.

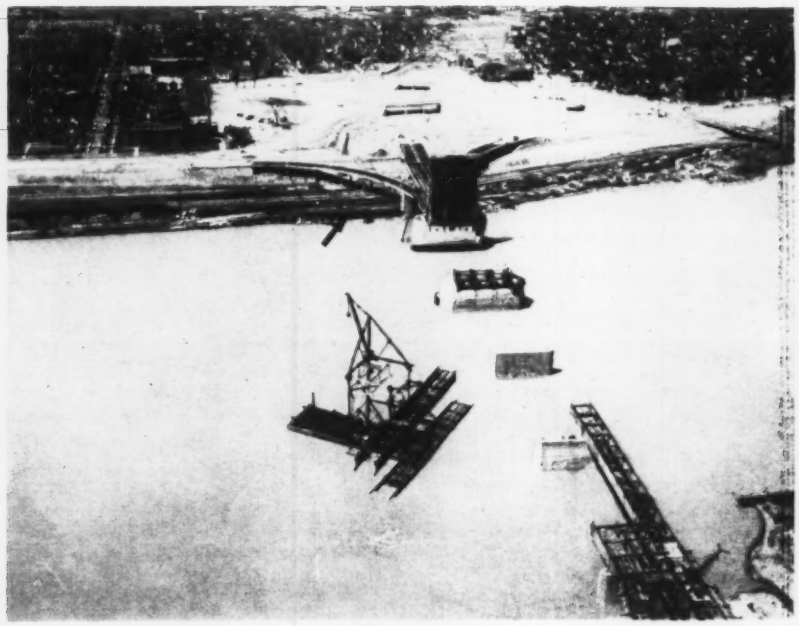
*John P. Hogan, 1940*

*Ezra B. Whitman, 1943* — *Malcolm Pirnie, 1944* — *J. C. Stevens, 1945*

*R. E. Dougherty, 1948* — *Gail A. Hathaway, 1951* — *Carlton S. Proctor, 1952*

*Walter L. Huber, 1953* — *D. V. Terrell, 1954* — *Wm. Roy Glidden, 1955*

*E. R. Needles, 1956* — *Mason G. Lockwood, 1957* — *L. R. Howson, 1958*



Preassembled pair of girders, weighing 280 tons, has been picked up on stern of derrick barge and is being carried to position in Toledo bridge. Arrow indicates dock where spans are assembled and loaded. Completed bridge is seen at far right.

# Big derricks erect steel for Toledo bridge

Specially built erection equipment and carefully planned sequence of construction resulted in the successful erection of huge units for the Craig Memorial Bridge over the Maumee River at Toledo, Ohio. A floating tower derrick with capacity for lifting 400 tons 60 ft above the water moved two girder assemblies from a shore assembly dock to their permanent position on piers. And a huge traveler reached out in front far enough to set a 165-ft, 100-ton girder unassisted.

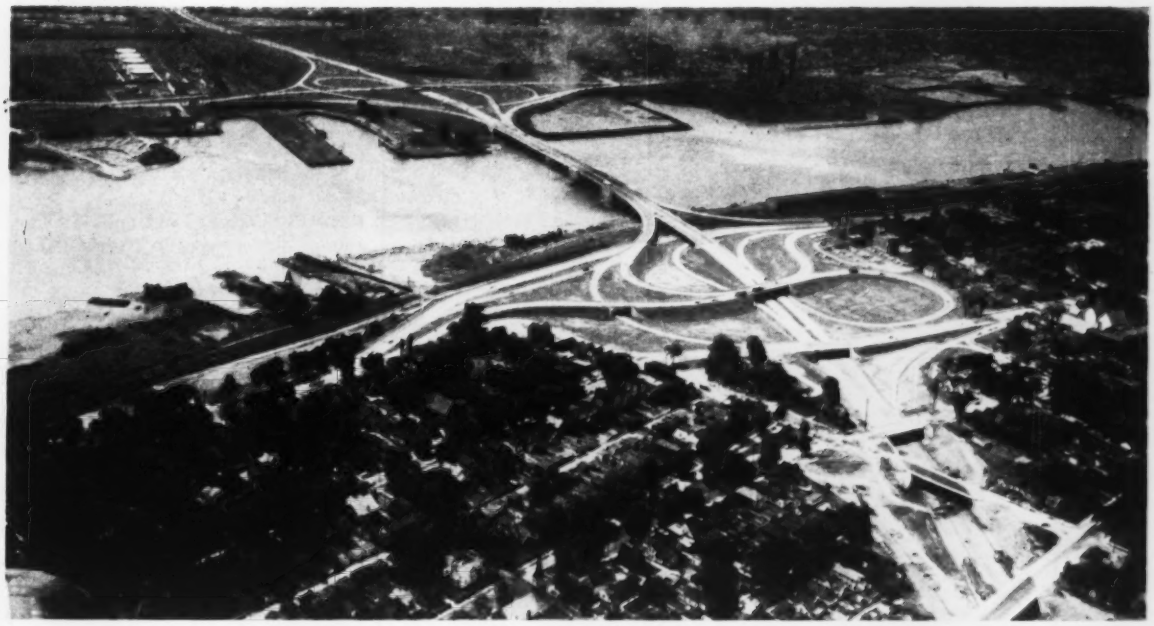
This largest structure on the Toledo Expressway System features a double-leaf bascule span 245.7 ft from center to center of trunnions and provides a 200-ft clear channel for navigation. The main central section of the bridge is 1,675 ft long and consists of four continuous girder spans. Two curved simple-span ramps make up the other approach to the bascule span. An open-deck grating is used on the bascule span while the other spans have a reinforced concrete roadway. The deck is 70 ft wide with 7-ft sidewalks on each side. The roadway is supported by stringers and floor beams, the floor beams framing into four parallel girders.

Designed by Howard, Needles, Tammen & Bergendoff for the State of Ohio, Department of Highways, the substructure was installed by Merritt-Chapman & Scott Corp., Cleveland Office. McDowell Company, Inc., of Cleveland, built the superstructure under a $5,133,333.33 contract, believed to be at the time the largest single contract ever awarded by the Ohio Highway Department.

Each leaf of the bascule span is composed of four trunnion bearing girders, the bearing being supported on steel columns within the concrete pier. The two interior girders of each leaf are actuated by a rack-gear segment having a pitch diameter of 33 ft 2 in. These unusually large gear segments were included in 456,000 lb of material furnished by the Wellman Engineering Company of Cleveland, Ohio, engineers and fabricators, a subsidiary of the McDowell Company, Inc.

Concrete in the upper part of the bascule piers, about 2,500 cu yd for each pier, was part of the superstructure contract. Trunnion support columns are embedded in this concrete. The first step in construction was to erect the columns with a floating revolving crane so that work could proceed on the concrete.

Next in order, two 70-ton crawler cranes erected the north approach to



**ROBERT C. McDOWELL, M. ASCE,** President, McDowell Company, Inc., Cleveland, Ohio

the pier near the edge of the river without interfering with daily train movements on any of the five tracks under this part of the bridge.

From the pier near the river edge to the north bascule pier, the distance is 165 ft—all over water. To erect this span, a specially designed derrick traveler was placed on the girders previously erected. Equipped with a 140-ft boom supported by a 115-ft tripod frame on a car 67 ft wide by 80 ft long, the traveler was designed to handle 100 tons at a 100-ft radius. From its erected position, the traveler completed the erection of the span out to the north bascule pier.

The longest and heaviest girder used —170 ft long and weighing 109 tons— is in this span. After being shipped in one piece, on four cars, it was unloaded and moved within reach of the traveler by the two crawlers. With the erection of this span completed, the traveler moved out to the bascule pier in position to erect the north bascule leaf.

The depth of the bascule girder at the trunnion end, about 20 ft, necessitated a longitudinal field splice in the web to conform to shipping clearances. These parts of the girder, together with the trunnion and drive rack, were assembled on a barge two at a time and riveted. The center girder assemblies weighed 115 tons each.

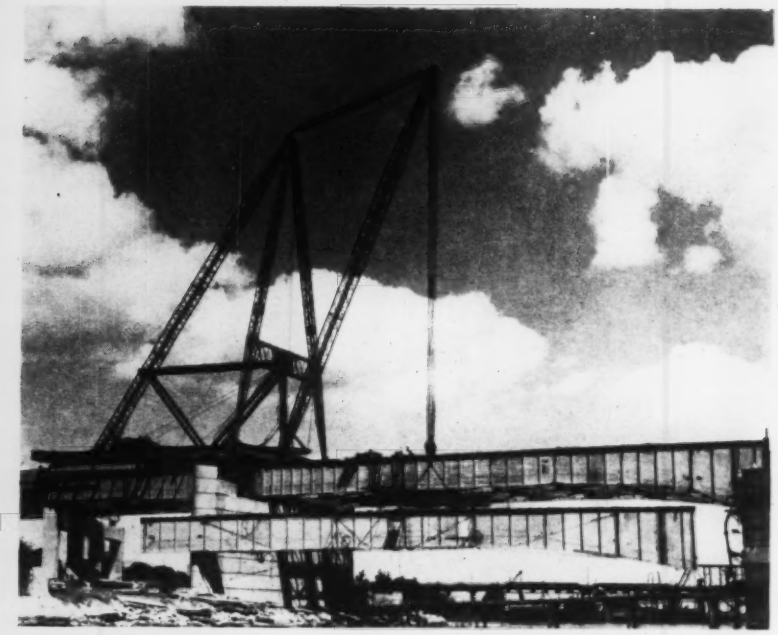
After the trunnion bearings were placed and aligned, the barge was moved to the front of the north bascule pier, then the traveler lifted the girders from the barge one at a time and placed them in the trunnion bearings and completed the erection of the leaf in the "down" position.

Next the counterweight was poured. Concrete weighing from 168 to 292 lb per cu ft was required to properly balance the bridge. The usual material for making heavy concrete, steel punchings, was in short supply and very expensive. A more economical solution was developed by McDowell Company's metallurgical division, which operates the Dwight-Lloyd Research Laboratory of mineral processes. A mix utilizing a heavy ore as coarse aggregate and a fine ore concentrate as sand, with only a nominal amount of punchings, was designed to produce the 292-lb concrete. The material was mixed on shore and dumped into a bucket, which was placed on a small steel float by a truck crane. The float, operated by haulage cables, moved the concrete out to the bascule pier where the traveler placed it in the counterweight.

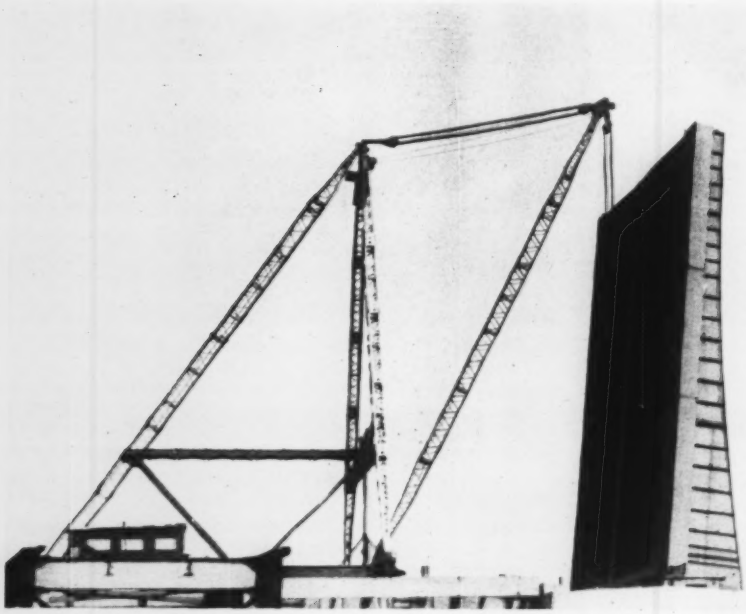
Erection was next begun at the south abutment. South of the bascule span the bridge consists of four-span continuous girders. Starting at the south abutment the spans are: 135 ft, 215 ft, 215 ft, and 193.5 ft. The span adjacent to the abutment is partly over land. This span and the girders extending over the pier to the splice at the quarter point of the second span were transported across the river by the derrick barge and erected individually by the floating derrick with the aid of a crawler crane on shore. The other three spans of girders were assembled in pairs and floated in by the derrick barge.

The floating derrick, designed especially for this job, was composed of a deck barge 160 ft long, 52 ft wide, and 12 ft deep, on which a tower 50 ft square and 80 ft high was erected. One pair of tower columns was located on the transverse centerline of the barge and the other pair 50 ft toward the rear. From the rear of the tower, two cantilever trusses, each equipped with hoisting blocks of 200-ton capacity, projected 15 ft parallel to the longitudinal centerline of the barge. On top of the 80-ft tower, a stiffleg derrick of 70-ton capacity was erected, facing the front of the barge.

A dock for assembling the girder



**Deck traveler erects a girder 165 ft long weighing 109 tons. Shadows show cable truss (in plane of top chord) used to stiffen girder during erection.**



**Specially designed derrick traveler has been moved out to bascule pier to erect near leaf in down position. Leaf was raised to up position as soon as possible to provide a clear channel.**

spans was made of two steel-pile bents 74 ft apart, measured along the water's edge, and extending about 50 ft inland. The ground between the bents was dredged inland to permit the barge to enter between the bents. (See arrow on photo, page 46.) The bents were capped with 14 WF 193 beams 18 ft above normal low water so that the barge deck could pass under the girders.

A pair of crawler cranes placed a 215-ft girder, composed of shipping pieces 97 ft and 118 ft long, on top of the bents about 25 ft from the landward end. A second girder was placed 22.5 ft nearer the land end. After the floor beams and stringers were filled in, the span was rolled to the water end of the bents and riveted while the cranes began the assembly of another pair of girders.

When a pair of girders was ready for erection, the rear end of the barge was floated between the bents and the 280-ton girder assembly was picked up by the blocks on the tower cantilevers. Anchor lines operated by hoists on the deck were used to maneuver the barge. When the barge had the girders positioned just upstream from the piers, parallel to their final position, the girders were raised slightly above the tops of the piers and floated into final position, where one end was spliced to the end of the previously erected girder and the other end landed on the pier. After the adjacent pair of girders was erected, the stiffleg derrick placed bundles of deck steel on top of them. The deck steel was placed by a 20-ton truck crane working on timber mats on the stringers.

The several pieces comprising the trunnion end of the bascule girders for the south leaf were assembled in place in the "down" position by the derrick. The tip ends of the girders were assembled in pairs on the dock and erected by the cantilever arms of the derrick barge after the counterweight was poured.

Transportation of material for this counterweight presented a problem because the spans south of the bascule pier could not be used in this operation since work was in progress on the roadway slab. The method adopted was to plank over the top of the bascule girders and, on this planking, to place a batching plant with a 4-cu yd truck concrete mixer. Material for the batching plant was transported from shore by the derrick barge and placed in the hoppers with a clamshell bucket operated by the derrick on the barge. Sufficient room was available on the planked deck to charge the truck mixer at the batching plant and maneuver it into position to dump the concrete directly into the counterweight boxes.

The 7,300 tons of structural steel used in the structure were fabricated for McDowell Company, Inc., by the Fort Pitt Bridge Company of Pittsburgh, Pa. Concrete work in the bascule piers, deck, and sidewalk, as well as construction of the operator's control house, was sublet to George W. Lathrop and Sons, Inc., and installation of lighting and electrical equipment was sublet to Saunders Electric Company, both contractors of Toledo, Ohio.

Personnel of the State of Ohio Department of Highways associated with this part of the Toledo Expressway were: G. M. Lieber, Division Engineer; J. W. Kotch, Construction Engineer; P. J. Eckert, General Project Engineer; and F. L. Langenderfer, Job Engineer.

Superintendent for McDowell Company was John Covert and Project Engineer was Richard McQuivey. H. E. Banks, Vice President—Construction, sponsored the job.

**Earth and rock fill Adaminaby Dam in Australia, 380 ft high, was completed two years ahead of schedule by American firms.**

# Foreign work has special problems

**GEORGE HAVAS, M. ASCE,** Vice President and Chief Engineer, Henry J. Kaiser Co.

General Manager, Heavy Construction Division of Henry J. Kaiser Co., Oakland, Calif.

Foreign engineering and construction work usually involves most of the problems that beset a domestic project and a large number of different and interesting ones peculiar to the particular area. Projects in Australia and India, differing widely in character, will serve as illustrations for some generalities on all foreign work.

The Australian project is being carried out by a joint venture that holds several contracts for the Snowy Mountains Hydro-Electric Authority under the name of Kaiser-Walsh-Perini-Raymond. Henry J. Kaiser Company is the sponsor. The Indian project includes the design, procurement of machinery and equipment, and construction of a steel mill in Jamshedpur, India, for the Tata Iron and Steel Company, Ltd. On the latter contract the engineering was performed by Kaiser Engineers and the construction by Kaiser Engineers Overseas Corp.

The Snowy Mountains scheme will eventually collect, from the mountains in southeastern Australia, runoff that normally flows into the Pacific Ocean, and divert it westward to irrigate the vast arid plains of central Australia. From this diversion 3,000,000 kw of power will ultimately be developed. The project was designed for the Australian Authority by the U. S. Bureau of Reclamation and its execution is generally similar to a heavy construction contract in the United States. On May 31, 1954, our joint venture obtained contracts for a tunnel 14 miles long and 24 ft in diameter, called the Eucumbene-Tumut Tunnel, and for the concrete-arch Tumut Pond Dam, 290 ft high, together with a pressure tunnel 8,000 ft long and 24 ft in diameter.

The 14-mile tunnel was excavated from three headings. One shaft 300 ft deep, located four miles from one end and ten miles from the other, was used for two headings; one heading was at the Eucumbene Portal. Notwithstanding the language difficulties (there were 27 nationalities on the job) the tunnel crews under the able supervision of one walker at each heading broke one world record after another, averaging 37 ft per shift and reaching a maximum of 484 lin ft in one week. The contract completion date for the Eucumbene-Tumut Tunnel is March 1961. It is expected that all work on the 14-mile tunnel will be completed by June 1959. Tumut Pond Dam was completed in October 1958, cutting six months off a fast construction schedule. The major quantities in these two contracts approach 1,700,000 cu yd of excavation and 400,000 of concrete.

This same joint venture group was awarded a contract for the Adaminaby Dam by the Public Works Department of the State of New South Wales in June 1956. The project consisted of an earth and rock-fill dam 380 ft high, containing over 8,000,000 cu yd of fill. The contract completion date was May 1960, but all the work was completed by May 1958, two years ahead of schedule.

The total contract value of these three projects is $59,000,000. At the peak of the work the total cost of the equipment utilized was almost $10,000,000.

Of a very different type is the steel mill project in India, which consists of enlarging the capacity of an existing steel plant, founded in 1908, from about a million to two million tons a year. The facilities to be added include a blast furnace of 28-ft diameter, a by-products and coke plant, a sintering plant, a large open-hearth shop, a blooming mill, a sheet bar and billet mill, and a complicated structural mill. The Tata job requires 1,800,000 cu yd of excavation, 260,000 cu yd of concrete, and 45,000 tons of structural steel in buildings, excluding tonnages of machinery and equipment.

The cost of the construction equipment used on the Tata job is over $3,000,000. The total value of the contract is about $140,000,000. The contract was signed in December 1955, the date preliminary engineering design started. In slightly over 30 months we have put nearly all the major units in operation.

It is of interest to note that the Indian government is concurrently building two steel mills, each with a capacity of a million tons. One, being constructed by the Russians, was contracted for in February 1955, with a completion period of a bit over five years. The other, a German mill, was contracted for in November of 1955 for completion within four years. Both of these require considerably more time than our schedule. A third government mill, being built by English engineers, is not in a

**Big cableways placed concrete in the 290-ft-high Tumut Pond Dam in Australia's Snowy Mountains hydroelectric development.**

**Much work in underdeveloped countries still is economically done by hand. Here workmen dress blocks for Tata Iron and Steel Co. project in India.**

competitive position with our project because it started subsequently.

The basic differences between American and foreign construction methods may be summed up in two words—efficiency and speed. To this should be added judicial use of construction equipment. At the peak, 18,000 were employed on our job in India. The supervision and management group consisted of 102 American engineers and superintendents. About 25 of these handled design activities in India and the remaining 77 were construction supervisors. In the same area a British contractor employing 3,000 had a total supervisory staff of three men—a manager, an engineer and a superintendent.

The methods employed by the British firm are identical with those to which the local labor is accustomed. This firm and ours actually performed similar foundation work side by side. The foundations consisted of blocks about 20 ft wide, 50 ft long and 30 ft deep, separated by a space of some 15 ft. We opened up the entire area with a power shovel, which excavated the space between the concrete as well as the required foundation. After placing of concrete, the area was backfilled between the concrete piers.

The local method utilized every effort to leave the ground between the piers untouched. The individual pits were shored to permit safe working space for the men who swarmed all over the place, digging the earth by hand and transporting it to a disposal area on a human conveyor. The end result was obvious. By the American method the work was performed in three months; by the other method the same work required eight months. Utilizing heavy equipment does not, however, provide livelihood for the multitudes, many of whom are starving in heavily populated areas of the world.

To meet this problem, on the construction of a skyscraper in Singapore, a materials tower was provided outside the skeleton of the building. But instead of a hoist to move materials from the ground to the various floor levels, there was a staircase inside the shaft zigzagging up, and people were stationed along it within reach of one another. Supplies were handed from one man to the next until they reached their destination. To the question of why a power hoist was not used the answer was: "We certainly could do that—but then what would happen to the people who are employed in hoisting the supplies?"

## Mechanization not always the answer

It is obviously necessary in foreign operations to use American labor-saving devices judiciously. In most cases, the equipment is expensive and maintenance is substantially higher than in the United States. There are two causes —lack of ready availability of spare parts, and less skilled maintenance mechanics. In India for example, concrete aggregates are customarily crushed by hand. If there is ample time and the quantities required are within the physical capacity of the people, it is cheaper to continue the hand-crushing procedure. This provides employment for additional local people.

It is a mistake to assume that indigenous labor cannot be taught to operate machinery or to become familiar with new trades and skills. Similarly, it must be recognized that engineers in other countries are usually well versed and qualified in engineering theory although they may lack practical experience.

On my first visit to Calcutta I noted excellent workmanship on steel structures but also noticed that no welding was employed. I met with all the steel fabricators of Calcutta to determine how much structural steel they could furnish for the Tata project. They were able to provide some 20,000 tons, and we had to import approximately 25,000 tons. At this meeting I asked the fabricators why they did not utilize welding. The answer was simple: their engineers knew how to weld but there was no one to instruct the workers in how to use welding tools. This was due to the tremendous gulf between the standing of a professional man and that of a laborer.

In India the earnings of an engineer range from 800 to 1200 rupees per month, while common labor earns from 2 to 2½ rupees a day, totaling only 50 to 60 rupees a month. In the United States the rate for common labor averages $2.00 an hour, or about $350 a month, as compared to the salary of an engineer, which may be from $600 to $1,000. The rates quoted for both India and America are for comparable skills. The ratio between the earnings of an engineer and a common laborer in India is roughly 20 to 1, while in the United States it is 3 to 1.

This gulf makes it obvious why the qualified Indian engineer finds it beneath his dignity to use a hand tool or to teach its use. In contrast to this attitude, Kaiser established a welding school on the Tata project and after two months our superintendent reported that he had trained over 80 welders. He commented to me that he would put any one of 25 of these welders up against an American welder at any time.

In the United States parts and equipment can be obtained "off the shelf"

**American know-how expanded capacity of Tata steel mill in India by a million tons in 30 months. Concurrently Russians are building a million-ton mill in India to be completed in five years; Germans will complete a similar mill in four years.**

in a few days. On work that Americans do in other countries this is not the case. Shipments of materials, equipment and supplies can frequently take four to six months for delivery. Special attention must be given to import restrictions and licenses. Sometimes a much needed piece of machinery has been held at a port of entry while its job was done by makeshift methods.

Transportation across national boundaries sometimes is troublesome. Rail gages change—in Australia even between adjacent states—requiring time for transfer and exposing the cargo to damage, loss, and pilferage. Subcontracting of specialized parts of the work is unknown in many countries. This forces a do-it-yourself operation on general contractors in foreign fields for parts of the work not normally handled by them.

A problem seldom faced here at home is that of assisting in the financing of a project. When a construction firm considers a contract for a job in the United States, the problem of financing more than the start and current outlays is seldom if ever one of the headaches facing the contractor.

This is not the case in many foreign countries. Even though their treasuries are solvent they are generally faced with the problem of "foreign exchange." In many cases the engineer and the constructor are requested to assist in obtaining the foreign exchange requirements, particularly the U.S. dollar requirements, before a project can be undertaken.

Many contracts for projects in foreign countries are awarded on the basis of international competition. Because of our high standard of living, and consequently high cost of labor and salaries, an American engineer and contractor is generally at a disadvantage when competing against British, German, French, Italian and Dutch firms. By and large, our salaries are three to five times higher than the equivalent salaries of European competitors, and usually many times higher than those earned by local people of comparable standing.

The higher salaries of American personnel on foreign projects pose a public and employee relations problem at the job level, which has to be handled with great diplomacy. The disadvantage of higher salaries for Americans is offset by the efficiency and speed of American construction methods which these men carry with them.

To digress briefly from Australia and India, I would like to relate a pertinent story from another continent. We recently built an automobile plant in Argentina. We broke ground in March 1955 and placed the plant in operation in the spring of 1956 on schedule—notwithstanding three revolutions. The local people did not believe the newspaper articles reporting completion of the job. Nothing was ever done that fast and therefore "it could not be done."

Jack Hughes, in charge of the project and now Assistant General Manager of Kaiser Engineers, when congratulated on the fast schedule, insisted he was not entitled to any praise because he had done nothing differently from what he would have done at home.

Considering business problems in general, it is very important for the American engineer to familiarize himself with the tax problem in any country where he is to work. Tax problems are important both to the corporation performing the work and to the individual American employee.

Some countries have a tax convention with the United States. One of these is Australia, where the individual income taxes of an American employee would be substantially higher than his American taxes. However, because of the tax convention, an American citizen performing work in Australia for a period of three years need not pay any higher taxes than he would be required to pay to the United States Internal Revenue Service.

We have no such tax convention with India. But to induce foreign technicians to go there, the Indian Board of Revenue exempts them from paying any income taxes for a period of two years. Corporations will usually find it advantageous to use a local subsidiary to reduce income tax liabilities.

A common mistake in preparing competitive proposals for other countries is to base the estimates of cost on conditions in the United States and then use factors to convert these estimates to totals applicable to the country in question. In preparing such a conversion it is usually assumed that the productivity of foreign labor is less than that of American labor and therefore it is frequently the practice to multiply the man-hours needed in the United States by a factor such as 2, 3, or even 10. The practice of basing estimates on American manpower requirements and using a conversion factor often gives erroneous results, as indicated by some of my examples. A very careful and detailed study is necessary to determine applicable labor cost factors in any particular country, especially where the nature of the work requires a large amount of labor.

### Work with local people

It is important, before sending American personnel overseas, to acquaint them fully with local conditions. The greatest cause of dissatisfaction and turnover is attributable to the fact that personnel, and particularly their families, do not understand the conditions they will encounter upon arrival in a foreign country. Well informed American personnel and their families can be magnificent good-will ambassadors for our country.

It is desirable to rely on local engineering talent. We do not know it all, and even an exhaustive investigation will fail to disclose all information regarding local codes, conditions and practices. Do not overlook the fact that foreign engineers are also well qualified.

A stage has been reached where we can truly say that the world is our market, and American engineers and contractors abroad can do as much as any other group of Americans in advancing the cause of a free world.

Asphalt resurfacing 3 in. thick is being placed in two courses on runway 150 ft wide at Ontario International Airport, California. Placing equipment is from Industrial Asphalt, which rents such equipment and supplies bituminous materials to general contractors. Cessna plane enables supervisors to keep in close contact with plant and field and to deliver parts needed in an emergency.

# ASPHALT RESURFACING of an operating airport

E. J. WOODWARD, Jr., Chief Engineer, Industrial Asphalt, Los Angeles, Calif.

A concrete runway 6,200 ft long and parallel taxiway were resurfaced with asphalt in a period of only 12½ days, at the Ontario International Airport in San Bernardino County, Calif. On this $118,100 resurfacing job, some 24,000 tons of asphalt were placed. A surface 3 in. thick was placed on the 150-ft-wide runway and one 2 in. thick on the 50-ft-wide taxiway. Not only were surface deficiencies corrected but also the wheel-load capacity of the pavement was increased.

The fast repair schedule was established to keep the airport in operation and to reduce to a minimum the inconvenience to traffic, which is heavy. Landings and takeoffs occur at an average of 13,000 per month. The airport accommodates two scheduled airlines and an Air National Guard jet fighter group. It also is a commercial overhaul center for planes and for jet engines. Heavy Aircraft are flown to this rehabilitation center from all parts of the world. During runway repair, a taxiway had to be used for even the largest aircraft, accentuating the need for the most rapid possible means of repair.

The load bearing capacity of the runway and taxiway was to be increased by 15,000 lb per single wheel, to 60,000 lb. This loading meets the requirements of all the known commercial aircraft, including jet transports. The Civil Aeronautics Administration required a mix that would carry a 200-psi tire pressure. The mineral aggregate was ¾-in. maximum size, mixed with 5.5 percent of 85-100 penetration-type asphalt.

On the original runway the concrete slab was 5½ in. thick at the center and 8 in. at the sides. In preparing the runway for resurfacing, the concrete slab was swept twice. The first sweeping, carried out about a week before the resurfacing started, was done with an ordinary city-type street sweeper. The second sweeping, done just before the tack coat was applied, was done with a pull-broom hauled by a truck.

A tack coat of RS-1 penetration-type emulsion was placed on the runway at the rate of 0.07 gal per sq yd. To determine when the tack coat was to be applied, and how much, a continuous check on weather conditions was maintained through the CAA Weather Bureau so that the weather would not affect the tack coat before the asphalt resurfacing was placed. The tack coat was sprayed on by the General Petroleum Company with a spreader truck. At the start, only enough tack coat was sprayed on for a half day of resurfacing. Later, depending on weather conditions, the tack coat was spread early each morning for the full day's run of resurfacing.

When resurfacing started, progress was slow because of the short "pulls" and transitions. It was helpful to use the same crew on the spreader truck each day as they could work with a minimum of direction.

Industrial Asphalt furnished all asphalt paving materials and most of the laydown equipment and rollers for the job. Materials were hauled from Industrial Asphalt's Standard Steel plants located at Mira Loma and Fontana, Calif., at the rate of 2,000 to 3,000 tons per day. In one 9-hour period, two Barber-Greene spreaders placed 3,010 tons of resurfacing material. Two machines were used for only about half the job as there were numerous transitions and "short pulls" at intersections.

Two lifts of asphalt paving material,

Top course of runway resurfacing is laid by Barber-Greene spreading machine and compacted by Buffalo and Bros rollers.

Asphalt resurfacing shows black in photo of Ontario International Airport in California. Use of asphalt permitted economical "feathering out" to form smooth transitions with other paving.

each 1½ in. thick, were laid on the runway for the total of 3 in.; one 2-in. lift was laid on the taxiway. The specifications required a relative compaction density of 92 percent—easily attained by use of one Buffalo two-axle tandem roller, two Buffalo three-axle tandem rollers and one Bros two-axle nine-tired pneumatic roller. The two-axle tandem roller, used to break down the asphalt, was followed by the three-axle roller to improve the initial compaction. Close behind came the pneumatic-tired roller, making a final pass as the asphalt was starting to cool. The next morning, the three-axle roller made two passes over the previous day's run, thus increasing the density by 2 percent. A compacted density of 96 percent was attained by this operation.

The Marshall test was used to determine the stability of the mix. A minimum stability of 1,000 lb was required, but with the additional rolling and the controlled-mix design, a Marshall stability of 1,800 lb was obtained.

While the taxiway and the runway were being resurfaced, another asphalt-surfaced taxiway, located south of the airfield, was in use as the main landing strip. Heavy-duty aircraft of all types landed on this strip during the resurfacing program, even Lockheed Constellations and military jets. The contractor was obliged to stay clear of this taxiway, and all his vehicles were required to carry visibility flags. When his equipment was working near this taxiway, operations were controlled by mobile radio units in communication with the control tower; he was required to stay clear as the planes came in for a landing.

Use of asphalt simplified the problem of carrying the rebuilt runway and taxiway across a diagonal concrete runway that was not being resurfaced. The asphalt was feathered to form a smooth transition, which permitted smooth high-speed crossings of the runway.

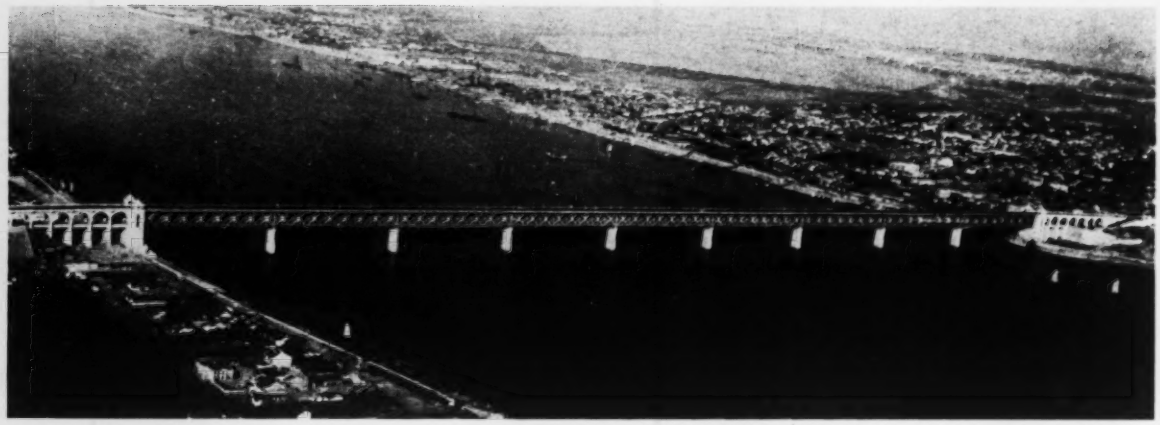
Another problem was the expansion joints in the old concrete. Several ideas were tried to assure a smooth surface. The method that proved most satisfactory was to carefully clean out each expansion joint and cut it down even with the existing concrete, or lower if possible. If the joint filler was about level with the existing concrete it was not removed. Resurfacing was placed over the joints just as if they were not there.

When part of the runway was finished, night flights were allowed to land and take off on the new resurfacing and on other parts of the runway that had not been resurfaced, or on which the tack coat had not been applied during the day. At no time was the airport completely closed to the flow of air traffic. Surfacing with asphalt kept repair time and inconvenience to a minimum.

The operation was well timed, scheduled and managed by Thomas E. Flaherty, Airport Manager, and Richard W. Rogers, Airport Engineer. To insure the continuous operation of the airport, Basich Bros. Construction Co., the general contractor, and Industrial Asphalt, the materials supplier, worked in close coordination to schedule the flow of materials and equipment so that the job could be done quickly and efficiently. Pacific Materials Laboratory of San Bernardino worked with Industrial Asphalt's Material Lab on the initial design and load testing before the job started. This insured the proper design and placing of a surface that will economically serve for many years.

# The Yangtze River Bridge at Hankow, China

**YI-SHENG T. E. MAO,** Dr. Eng.; Chairman, Board of Consulting Engineers, Yangtze River Bridge, Peking, China



**Yangtze River Bridge at Hankow consists of three continuous rhombus trusses of three units each. Nine spans of 420 ft each make up the main-channel length of 3,780 ft. The eight river piers are supported on unusual tubular piles driven by a newly developed vibrator. Piles were driven through heavy overburden and founded in sockets drilled into rock.**

The Yangtze River Bridge at Hankow, the first bridge over the biggest river in China, was designed by Chinese engineers, built with Chinese steel and machinery, and financed by Chinese money. Actual construction work for the bridge was begun in September 1955, and completed in October 1957, two years ahead of the original schedule.

It is a combined railway and highway bridge, with a double-track railway on the lower deck and a six-lane highway on top. The total length of the main span is 3,780 ft; the structural approaches on one bank are 994 ft long and on the other, 691 ft. The total Yangtze bridge system is composed of this Yangtze River Bridge, 8 miles of connecting railway line between the Peking-Hankow and Canton-Hankow Railways, and 3 miles of roads joining highway networks of northern and southern areas of China and uniting Hankow, Hanyang, and Wuchang, formerly separated by the Yangtze and the Han Rivers, into one metropolitan area.

Caisson piles of 1,000-ton capacity were installed by a vibratory driver through heavy overburden and founded in sockets drilled into rock. An unusual frame held these caissons for driving through overburden or for installation on bare rock with a heavy dip, and this in a river where high water lasts seven months a year with flows up to 2,700,000 cfs, equivalent to the maximum flow of the Mississippi.

The superstructure of the bridge proper consists of three units of three-span continuous steel trusses, each span 420 ft long. The double-deck structure has rhombus-type trusses equivalent to a double Warren system. All were erected by a cantilever system especially planned for in the design, and described later. The superstructure type adopted required eight piers in the river plus land abutments and substantial approach structures.

## Subsurface difficulties

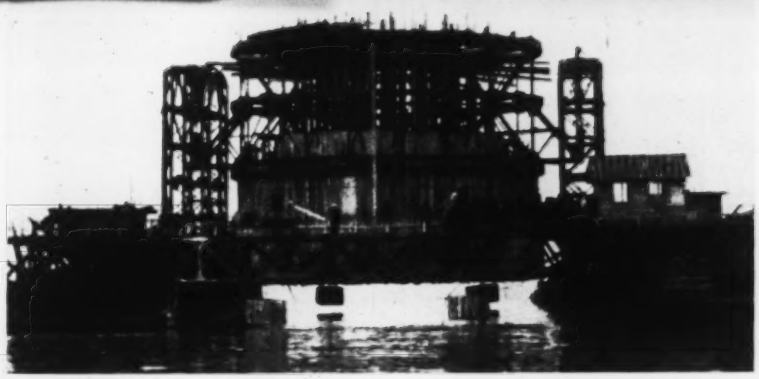
The river bottom at the site varies from bare rock to a 90-ft depth of overburden, under 20 ft of water at low flow and 80 ft at flood flow. The overburden is unstable fine sand underlain by coarse sand and gravel. This is subject to constant scour, with profile changes of as much as 30 ft in a year from current velocities ranging up to 10 fps (7 mph). Bedrock is limestone, marl or shale with a multiplicity of laminations and a dip of 70 to 80 deg. To determine rock configuration and condition, five bore holes were drilled 60 to 125 ft into the rock at each pier location.

Early plans contemplated the use of pneumatic caissons for the foundations of all the piers. But the depth of more than 115 ft below the water surface, even during the short low-flow season, indicated a long construction period. Differences of elevation within the limits of a pier base amount to 16 ft, thus greatly complicating rock excavation.

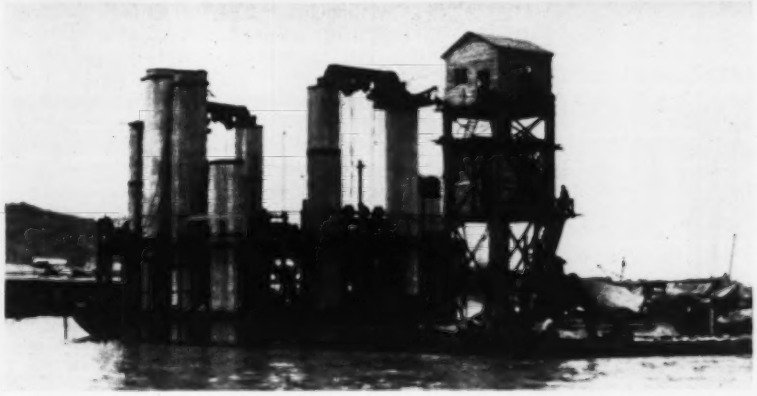
## Colonnade foundation

After an examination of many methods, and at the suggestion of K. S. Cilin, a Soviet expert, the idea of a "colonnade" foundation was developed. For this a number of large, hollow reinforced-concrete columns are securely anchored into the bedrock (similar to Drilled-In caissons in this country), and concreted into the pier base to support the structure. After a column has been sunk open-end to rock and cleaned out, a socket is drilled into the rock. A cage of reinforcing steel, which is lowered into the socket, extends well up into the column. Tremie concrete bonds the column to the rock socket to give a high-capacity member.

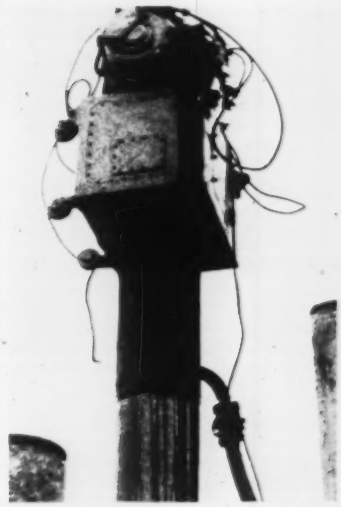
For the Hankow bridge piers, 30 to 35 tubular columns are arranged in three circular rows to support a pier base of 55-ft diameter. Each column has a diameter of 61 in. and a 4-in. wall. The columns were generally precast in 30-ft sections but 10-, 20- and 40-ft lengths were available for top units. The columns are made of 2,840-psi, minimum-strength concrete reinforced with



Steel frame serves as guide for tubular columns and template for the sheetpile cofferdam.



Driving frame was supported on a few of the tubular caissons during completion of each pier. This permitted work to continue throughout the seven-month high-water period of each year.



Vibratory pile driver has fast rotating eccentrics that force open-end tubular caissons down rapidly.

44 bars of ¾-in. diameter and ⅜-in. spiral hoops spaced 6 in. on centers. At each end of a section a steel flange, in the form of a collar, is welded to the reinforcing, exactly perpendicular to its axis. The flange plates of abutting sections are connected by 42 bolts of ¾-in. diameter and may be welded for a permanent connection. The bottom section of each column is fitted with a 4-ft-long driving shoe of ⅝-in. plate.

### Guide and work frame

A guide frame was used to give the exact location of each column. The frame served as a template for a sheetpile cofferdam for the tremied concrete pier base and as a work platform for construction. The frame, 55 ft in diameter, was of structural steel in a latticed cylindrical cage with horizontal steel rings 21 ft on centers vertically. A definite space was reserved in the framing for positioning each support column.

The two lower rings were assembled on a 440-ton pontoon and supported at each side by a guiding pontoon which had elevated towers and blocks for lifting the guide frame, as shown in a photograph. When the unit had been floated to exact position and anchored, the center pontoon was withdrawn. The frame was lowered and two additional rings placed in successive operations making a total height of 63 ft. Lowering continued to plan location at the bottom of the tremie seal. Eight to 14 of the 61-in. tubular columns were sunk through selected openings and anchored into rock, then used to support the guide frame, releasing the pontoons while the remaining columns were placed. Work could then continue year round despite high water.

Sinking of the tubular columns was accomplished by the combined action of a vibratory pile driver and water jetting. Successive sections, to make a minimum of 130 ft, were connected and lowered until the bottom section reached the river bottom. By means of the vibratory pile driver and the use of four jet pipes attached on the outside of the column and one pipe inside the column, the columns were sunk to bedrock through the sand deposits without great difficulty. During sinking, the soil inside the column was removed by dredging or suction. The jet pipes were 3 in. in diameter and used 440 gpm of water per jet at 175-psi pressure.

The vibratory driver was firmly connected to the flange of the uppermost section of the column. Because of the vibratory action of the eccentric weight in the driver, the column was subject to vibratory force at great frequency, thus loosening the adhesion between the wall of the tube and the soil in contact. Aided by the jetting, the column was forced to sink by its own weight and the weight of the driver.

The vibratory driver was made at the bridge site after development of the design from Soviet models. The principle is to have a pair of load-carrying axles revolving at high speed in opposite directions. On each axle is an eccentric weight. When in horizontal alignment, the two weights will balance each other, but when both are in a vertical position they will combine to produce up and down vibrating forces. Vibrators have been made with various characteristics. The vibrating force may be 19, 47, 100, or 132 tons; the weight of eccentrics, 6200, 5000, or 6000 lb; the number of eccentrics, 10, 15, or 20; the eccentricity, about 5 in.; the number of load-carrying axles, 4, 6, or 8; the number of revolutions per minute of the load-carrying axles, 408, 450, 900, or 1,000. More powerful vibratory drivers are now being made with a vibrating force as great as 460 tons for installing tubular columns with diameters of 10 ft and 16.4 ft. Two to six tubular columns can be sunk every 24 hours, penetrating sand deposits up to 85 ft deep.

### Socketed into bedrock

After a tubular column was sunk to bedrock and the soil inside removed, a hole of the same diameter as the inside wall of the column tube (53 in.) was

Plans for this project were prepared in metric units. English equivalents given are approximate.

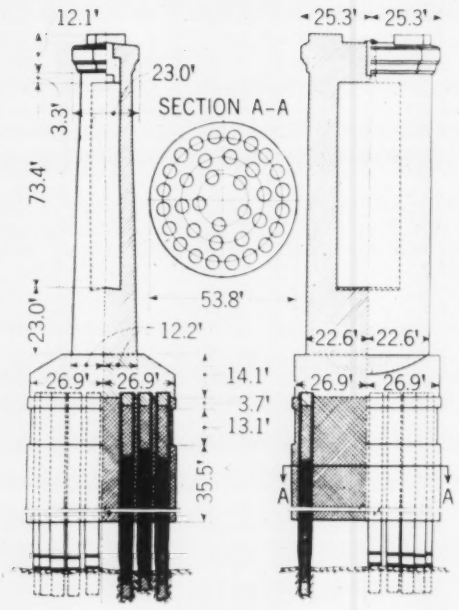



**FIG. 1. Typical pier rests on colonnade foundation of 61-in. tubular units.**

drilled into the bedrock to a depth of 7 to 20 ft. The boring bit, of tempered steel in the form of a cross 51 in. wide, had a curved cutting edge attached to the end of each arm of the cross. The 4.4-ton bit was dropped 2 to 3 ft, 30 to 40 times per minute.

After drilling to a depth of 3 or 4 ft, drilling was stopped and the debris removed by a cleaner. When boring into a limestone formation, clay blocks were thrown into the hole to pick up the cuttings and facilitate their removal. This clay-paste method is not necessary in marl.

Since the bedrock slopes on a very steep grade, one side of the tubular column rested on rock while the other was high above it. To prevent sand and silt from rushing into the tube through this gap, 3 to 4 cu yd of tremie concrete was placed in the tube before the rock boring started. This plug of concrete effectively closed the gap and provided a comparatively plane surface for the start of drilling. [On similar work in the United States, paving cobbles thrown into the gap have proved more successful.]

The speed of drilling the 51-in.-diameter hole into the rock varied with the type of machine and the nature of the rock. A hole 10 ft deep in limestone usually required 20 to 48 hours. For all the piers in the Yangtze Bridge, 224 holes were drilled, with an aggregate length of 2,600 ft.

A steel reinforcing cage of cylindrical shape, 43 in. in diameter, was lowered into the hole, with its upper portion projecting high up into the tubular column. The cage contained 18 to 24 longitudinal 1½-in. bars and ½-in. spiral hooping spaced at 3½ in. Concrete was placed under water, filling the tube up to the sealing course of the pier base.

Underwater concreting of the hole in the rock and the tube of the column was accomplished by the use of a tremie pipe of 10-in. diameter, in a continuous operation. To assure a perfect bond between the concrete in the hole and the bedrock itself, jet pipes were attached to the tremie pipe so as to force up the debris by flushing with water at 150 to 220 psi. After flushing for 10 to 15 minutes, when all the mud and debris had been thrown into suspension in the water, the water jetting was stopped and, almost precisely at the same moment, the flow of tremie concrete into the bottom of the hole was started. The debris in suspension in the water thus remained above the concrete while the tremie concreting progressed without interruption. The top layer of concrete, which contained the debris, was removed.

While the tubular columns were being sunk, a steel sheetpile cofferdam was driven around the cylindrical frame. Sheetpiles of Larsen Type III were used: this is a deep-web unit with a section modulus of 25.42 per ft of wall. Three piles were joined and calked before driving to reduce the number of operations necessary in pulling. All 135 piles in the ring were joined before any were driven.

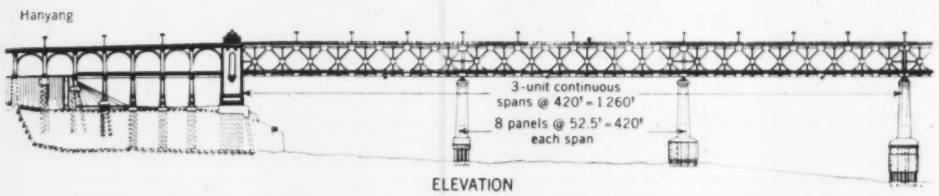
Sand within the cofferdam was excavated by suctioning to the required elevation, and the sealing-course concrete of the cofferdam was deposited under water through tremie pipes 10 in. in diameter and 100 ft long. Fifteen tremie pipes, each covering an 8-ft radius, were used. Since the sealing course was 20 ft or more thick, the concreting was done in two stages to permit loosening of the sheetpiles after each stage of concreting. A wood form for the sidewall of the sealing course of concrete was built around the bottom tier of the steel bracing frame before sinking. The footing course and shaft of the pier were placed in the dry after the cofferdam was pumped out. All the sheetpiles were extracted for reuse by 80-ton-capacity derricks.

## Experiments prove possibilities

Extensive experiments have been made in sinking tubular columns. Rates of sinking under different conditions, using a vibrating force of 132 tons at 500/1000 rpm of axle load, are shown. No jetting was used.

| Column Size | Depth Penetrated | Time, Minutes |
|---|---|---|
| *In clay:* | | |
| 5 ft 1 in. | 59 ft | 177 |
| 9 ft 10 in. | 59 ft | 207 |
| 16 ft 5 in. | 54 ft | 180 |
| *In fine sand:* | | |
| 5 ft 1 in. | 115 ft | 56 |
| 9 ft 10 in. | 75 ft | 14 |
| *In sand and gravel (with 16-in. boulders):* | | |
| 9 ft 10 in. | 53 ft | 113 |

**FIG. 2. Three-span continuous truss has one fixed bearing at an intermediate pier. The other three supports are on expansion bearings.**



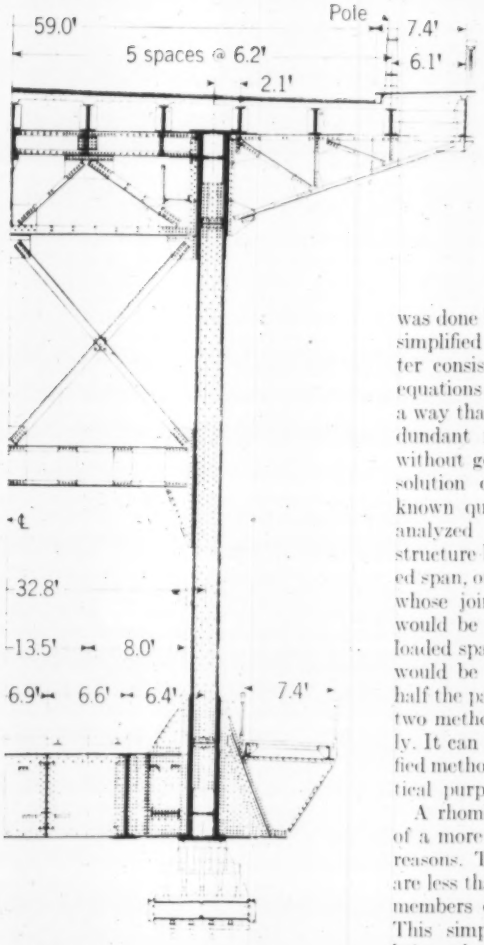



**FIG. 3. Lower-deck stringers and floor beams were placed at the same level to carry ties and rails directly. Highway deck and sidewalk are made up of prefabricated, reinforced-concrete slabs.**

It has been demonstrated almost conclusively that reinforced tubular columns can be sunk into almost any kind of soil to a depth of 100 ft or more by a vibratory pile driver, with or without water jetting. And a tubular column of smaller diameter can be installed inside the first to reach a greater depth. The larger tubes can be converted to pneumatic caissons, if necessary, by attaching air locks.

## Superstructure

The superstructure, as mentioned earlier, consists of three units of three-span continuous steel trusses. The two trusses for the double-deck bridge are 32.8 ft apart and 52.5 ft center to center of chords vertically. The rhombus-type truss has eight panels of 52.5 ft, each of which is again divided into sub-panels of 26.25 ft (Figs. 2 and 3).

The truss is a statically indeterminate structure, with two redundant reactions and three redundant members. In constructing the influence lines of stress for the different members, the calculation was done by the usual method and by a simplified method of analysis. The latter consists in transforming the usual equations of elastic deformation in such a way that the influence lines of the redundant reactions can first be found without going through to the complete solution of the other redundant unknown quantities. The truss was then analyzed as a statically determinate structure by assuming that, in the loaded span, only the system of diagonals on whose joint the unit load was placed would be acting; and that, in the unloaded spans, both systems of diagonals would be acting, each diagonal taking half the panel shear. The results of these two methods of analysis checked closely. It can be concluded that the simplified method is accurate enough for practical purposes.

A rhombus truss was chosen instead of a more usual type for the following reasons. The stresses in the diagonals are less than those in the corresponding members of a Warren or Pratt truss. This simplifies the joint details and brings the dimensions of gussets within the size limit of the sheared plates that can be economically turned out from the rolling mills. As compared with a K-truss, in which the stresses in the verticals are all different in magnitude, the stresses in the verticals of a rhombus truss vary in such a way that altogether only four different make-ups are necessary for all of them, thus greatly simplifying the process of fabrication. Further, in the rhombus truss, the splice lines of the chord members can all be placed right at the principal panel points to facilitate fabrication and erection, whereas in a K-truss, where the joint layouts are all unsymmetrical, this can only be accomplished at much greater expense.

However, the rhombus truss has the drawback that the maximum chord stresses near the supports are much less than those in the middle of the span. This is rectified by regulating the dead-load reactions at the end and intermediate supports, so as to even up the maximum stresses in the chord members. For this purpose, the main trusses were fabricated in the shop with a special camber. While in an untrussed state (on assembly frames or on falsework,) the end supports of the main trusses were 5½ in. higher than the intermediate supports. Bringing down the end supports during erection to the same level as the intermediate supports decreased the end reaction by 30 tons and accordingly increased the intermediate reaction by the same amount.

Members of the main truss were proportioned for cantilever erection without intermediate supports. This increased the weight by about 5 percent of the total of 21,300 tons of fabricated steel in the structure.

A special feature of the truss design is the make-up of the sections of the members, in which only H-shapes are used for webs as well as for chords, in open defiance of the usual practice. It has been found that the additional weight necessary for the required rigidity is more than offset by the much reduced cost of fabrication and erection, not to mention the greater convenience in maintenance. All the members, with no exception, are built up of plates and angles, the largest chord member being composed of six 43-in. vertical plates (two ¾ in. thick and four ⅝ in. thick); four 13 x 1-in. side plates; four 8 x 8 x 1-in. angles; and two 24 x ⅝-in. horizontal plates.

To simplify fabrication and facilitate erection, all similar members of the truss were made equal in length. The top and bottom chord members were made to splice only at the principal panel points. The camber in the truss was produced by adequately shifting by a small amount (plus or minus ¼ in.) the working points of certain diagonals meeting on the main gusset plates at the top chord joints. The resulting effect of eccentricity was of no practical significance.

All the members were built up and connected by rivets. The rivet diameter was ⅞ in. for shop assembly and 1 in. for field installation. The large section of the members required rivets with a grip of up to 7 in. For the structural steelwork, CT-3 bridge steel was used; for the rivets, CT-2 bridge steel; for the bridge shoes, cast steel; and for the rollers, CT-5 forged steel.

All the continuous trusses were erected by the cantilever method, using falsework for the first span only. To reduce erection stresses, all piers except No. 1 were flanked with erection brackets, built out 52 ft using "ever-ready" structural elements.

*(Henry Willcox, A.M. ASCE, of South Norwalk, Conn., obtained this article for CIVIL ENGINEERING. There has been no opportunity to check the details but the project has features that will interest, and perhaps challenge, constructors everywhere.)*

# Holland pushes back the sea

**HARRY H. POWER**, Professor of Petroleum Engineering, University of Texas, Austin, Tex.

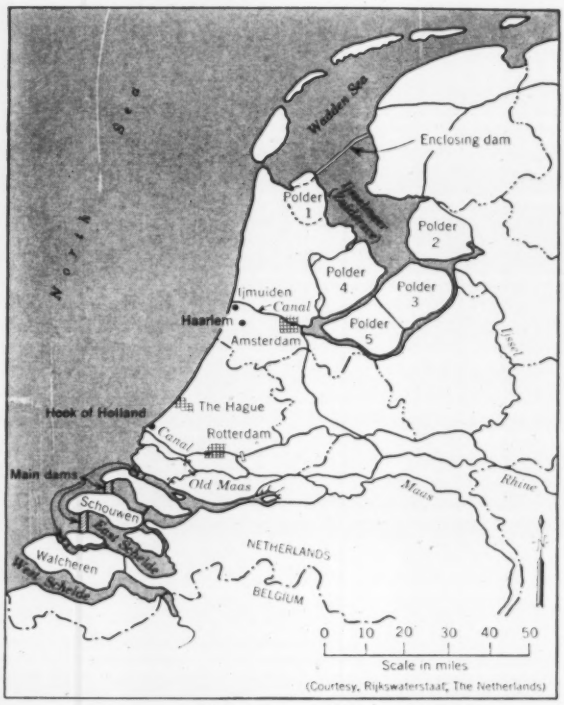



**FIG. 1. Major elements of plans to close the Netherlands coast against tides and storms of the North Sea are indicated on this map.**

The Netherlands has been described as a "sand and mud dump left over from the ice age." As the polar cap of northern Europe receded, residual material was deposited and transformed by tide and wind action into a fringe of sand and dunes like that in evidence today. The swamps created behind the dune were traversed by such mighty rivers as the Scheldt, the Maas, and the Rhine.

The first known settlers, the Friesians, came to this formidable area as early as 400 B.C., placing their homes on hillocks built of clay, which they transported from the marshes in willow baskets. The fight thus started against the sea has continued unabated throughout the intervening centuries.

Although the first dikes, built in the ninth century by William, Count of Holland (called "the Diker"), made the country more habitable, they left much to be desired. The struggle to maintain the Seawall or "Golden Hoop" has been of great historical interest. Repeated collapse, catastrophe, the inevitable toll of human life were usual occurrences in the early history of the Netherlands, and it was not until the sixteenth century that a reasonable degree of security was achieved.

In the eighteenth century, the "Golden Hoop" was extended from the seacoast to the banks of the rivers Maas, Rhine, and their tributaries. However, as a result the river beds were raised progressively and became choked by the deposition of fluvial sands. Ice jams occurred each winter, nagivation was impaired, and the dikes failed in numerous places. Eventually the harbor at Amsterdam lost depth because of silting, and the larger ships so vital to the nation's trade were unable to enter.

Work to dig canals across the country between these harbors and the sea was begun by King William of Orange in 1819 and completed in 1825, thus insuring at least temporarily the entry of deep-sea vessels into the ports of Amsterdam and Rotterdam.

In 1862, an earlier plan was revised to convert the main branch of the Rhine into a channel connecting Rotterdam with the North Sea. It was thought that stream currents would widen the initial trench cut through the dunes at the Hook of Holland and help to create a new deep-river channel. When this theory failed in practice, the advent of the steam dredge solved the problem. A new waterway from Rotterdam to the North Sea for large ocean-going vessels was dredged quickly in 1873, making this port one of the greatest in the world, surpassed only by New York and London.

After the Zuiderzee was formed in

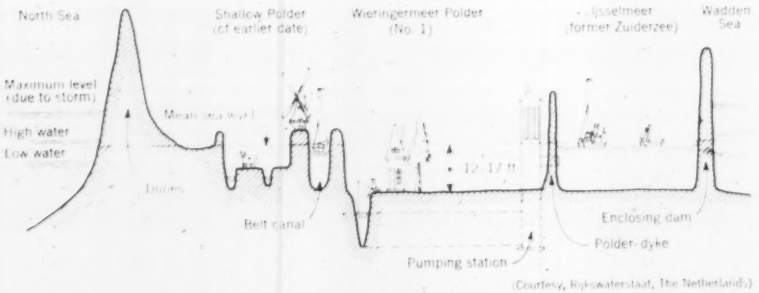
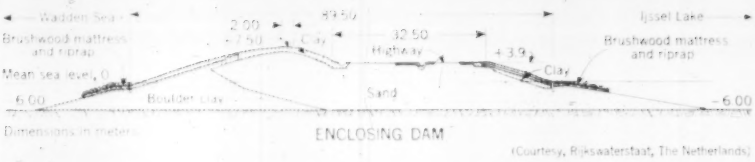



**FIG. 2. Ijsselmeer (Zuiderzee) project, begun in 1925, will reclaim 550,000 acres of rich farm land from the sea. This schematic cross section shows comparative elevation of new polders, to be 12 to 17 ft below sea level.**




(Courtesy, Rijksaaterstaat, The Netherlands)

**FIG. 3. Enclosing dike 20 miles long separates Ijsselmeer (Zuiderzee) from Wadden Sea, making the former a freshwater lake. Dike rises 22 ft above sea level, carries a highway and bicycle path, and provides room for a double-track railroad (photo above). Photo at left shows sluice gates which release water to Wadden Sea as required.**

the early fourteenth century, Amsterdam became a large port. The channel from Amsterdam to the North Sea through the Zuiderzee was used until 1824, when the route to Den Helder, northwest of Amsterdam, was dug, thus creating the largest canal in the world at that time. A new canal dug in 1876, from Amsterdam westward through the dunes, permitted the passage of the largest sea-going vessels. At Ijmuiden at the west end of this canal, the present lock 1,312 ft long can more than accommodate a vessel as large as the *Queen Elizabeth*.

The drainage of land by means of wind-power has been carried out from the fifteenth century to the present time, but has been supplemented in large measure by steam, diesel and electrically energized units, ranging from 10 to more than 500 hp. Uninterrupted pumping operations are of basic importance in Holland, since much of its economic security is based on agriculture, cattle raising, forestation, dairying, gardening and horticulture.

Approximately two-thirds of southern Holland is man made, and the remaining third is moorish swamp. Since the year 1200, the Dutch have reclaimed an estimated 1,453,000 acres of land along the sea shore, from former lake beds, and from the Zuiderzee. A total of 168,000 acres are yet to be reclaimed from the latter inland lake now known as the Ijsselmeer. This lake receives water from several rivers including the Ijssel, a branch of the Rhine. Although the losses in land since the year 1200 have exceeded the gains, a more favorable balance is anticipated when the drainage of the last polders in the Ijsselmeer will have been completed. In general, the word "polder" refers to an area requiring protection by dikes from high water coming either from the sea or from tidal rivers.

As the drainage and reclamation of the Ijsselmeer progressed, new farms and villages were created on land that was formerly sea-bottom. This gigantic project, one of the greatest works ever carried out for the promotion of human welfare, has for its main purpose the creation of some 550,000 acres of very rich and fertile farm land. Another important purpose of the work is to convert the Ijsselmeer into a freshwater lake not subject to the tides.

The gradual settling of land below sea level has permitted salt water to penetrate underneath the dunes and into the polders. Gas and cold-water wells were dug, and through them brackish water passed upward. The operation of locks such as that at Ijmuiden also permitted salt water to gain entrance to the lowlands. The drainage of waste salt from mines tributary to the Rhine has doubled the salinity of that river in the past twenty-five years.

Under the present reclamation program, the excess water in the Ijsselmeer is discharged at ebb tide through the sluices in the main or enclosing dike into the Wadden Sea, an arm of the North Sea. The level of this lake is almost at mean sea level. This constant-level lake will not only provide the region with fresh water for agricultural purposes and drain the polder land more efficiently, but also will combat the infiltration of salt water from the sea into the northern part of the country.

A plan to convert the Zuiderzee into land was mentioned in 1667, but it was not until the time of World War I that Dr. C. Lely, Minister of Works, persuaded the Dutch Government that the colossal project should be pursued to completion. In making this decision it was realized that the returns on the labor and financial outlay would not accrue to the present generation. It is estimated that the cost of the entire project will amount to some $550,000,000 by the time it is finally completed.

Construction of a 20-mile dike across the seaward opening of the Zuiderzee (Fig. 1) separates the latter from the waters of the Wadden Sea to the north. This dike is about 20 to 22 ft above mean sea level. Room for a concrete road, a bicycle path, and a double-track railroad is provided on the dike. See Fig. 3.

Materials entering into the construction of the dike include willow mattresses, clay and crushed basalt rock, brick and limestone. Unlimited quantities of heavy diluvial boulder clay at

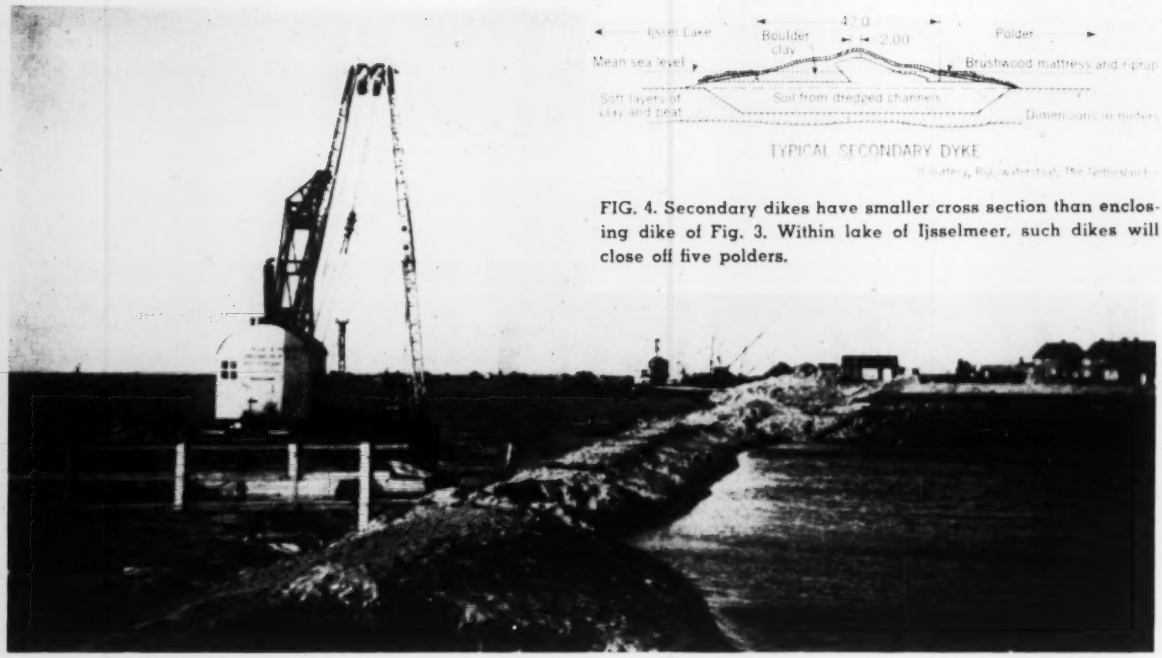



**FIG. 4. Secondary dikes have smaller cross section than enclosing dike of Fig. 3. Within lake of Ijsselmeer, such dikes will close off five polders.**

the bottom of the Ijsselmeer played a very important role in the construction program. Of unusual interest was the construction of the sluices and locks in the open sea before construction of the dike proper began.

Completion of the dike on May 28, 1932, was only the beginning of the project and a small part of the work of reclaiming the Zuiderzee. The latter, now renamed the Ijsselmeer as noted previously, is an inland fresh-water lake in which some hundreds of miles of secondary dikes will eventually outline the newly formed polders, totaling some 550,000 acres. See Figs. 1 and 2. The first and smallest of the polders, lying to the southwest of the enclosing dike, was completed and drained before the latter dike was completed. The second polder, with an area of 120,000 acres, was reclaimed in 1942, and the third was completed in 1957. Work on the fourth is going forward at the present time.

To protect the converted sea-bottom land, secondary dikes (Fig. 4) are constructed in such a way that, if the enclosing dike should fail, they will withstand the full strength of the Wadden Sea tides. Completion of the entire project is anticipated before the year 1980. It will have required nearly 60 years.

### Inundation of Walcheren Island

In 1944, the Allied Supreme Command ordered the inundation of Walcheren, a heavily fortified island in southwest Holland held by the Germans. Accordingly the dikes were bombed, and the four large breaches permitted the highly destructive tides to move in and out, becoming progressively larger with time.

By 1945, the gaps had enlarged to a width of approximately 1000 ft. The engineers entrusted with the task of closing the gaps were confronted with a loose sandy bottom, which presented an unusually difficult problem. After unsuccessful attempts using brushwood mattresses, which were floated into place and weighted with stones and tons of heavy clay, a number of so-called "beetles," or landing pontoons, were scuttled in one of the breaches. The success of this operation led not only to the use of concrete beetles in the remaining gaps, but also to the use of large vessels loaded with stone, Mulberry pontoons, tangled masses of torpedo netting and other war material.

To close the breach at Remmekans, 34 vessels were sunk in the gap. In addition, 36 tugs, 32 flush-deck barges, 14 bottom-dump barges, 5 cranes, 42 elevator barges, 6 sand-pump dredges, plus other material and facilities, were used in accomplishing this unusual task. Following the closing of the last gap came the draining of the land, rebuilding of villages and farms, and planting of crops.

The expenditures entailed in this work amounted to about four times the value of the cultivated land on the island, but in accordance with Dutch philosophy, the social and even the general economic benefits were believed to exceed by far the restricted private values.

This was part of the area devastated by the storm surge of February 1953, when the entire delta area of southwestern Holland, known as Zeeland, was flooded. In this flood 250 breaches in the 700-mile dike system caused 1,800 persons to lose their lives, 100,000 to be driven from their homes, and 400,000 acres of land to be flooded. Rehabilitation of the area was a task comparable to the reclamation of the Zuiderzee. Much had been learned from the work at Walcheren. The Zuiderzee works were stopped temporarily and the equipment shipped to Zeeland. With the enlistment of all possible aid, including students from the United States, Great Britain, Italy, France and elsewhere, the task was finally completed in less than a year. (For an eyewitness account of the closing of the tidal breach at Ouwerkerk in November 1953, see CIVIL ENGINEERING for October 1954, pages 33-37.)

### Projected closing of the coast

According to the long-range governmental plan, the eventual closing of the Dutch coast will be carried out in three stages:

1. The Zuiderzee (Ijsselmeer) Reclamation (1925 to 1975)
2. The Delta (Zeeland) Scheme (1955 to 1980)
3. The Wadden Sea Reclamation (not yet dated)

The Delta Scheme involves the area in southwestern Holland just described. To protect the lowlands, the closing of the entire Dutch coast is contemplated, thus making it invulnera-

**Hydraulic Laboratory at Delft conducts research on wave action, height of dikes, and silt movement—all needed for design and construction of Holland's reclamation system. Prof. J. T. Thijssee, standing at right, is in charge. Hydraulic model of a polder system is being studied at Delft Hydraulic Laboratory.**

ble to the sea's attack for an indefinite future period.

The first work projected by the recently formed Delta Committee involves the southwestern inlets between the Scheldt and the Rotterdam waterway. These are the largest and deepest estuaries in the country and are interconnected by large channels behind the islands of Zeeland. According to plans, eight dams will be built, four of them in the mouths of the main estuaries. The dams will have a total length of 25 miles and maximum depths of approximately 100 ft. It is estimated that the entire project will take about 25 years to complete.

### Other pressing problems

The Dutch Government knows that this and other great works must be done for a number of significant reasons: (1) many of the present dikes are inadequate, having been broken at thousands of places during the centuries and always repaired in a hurry; (2) the entire country is subsiding and the sea level is rising as a result of the melting of polar ice; (3) sand losses in the estuaries make them deeper each year and hence the currents become more threatening.

Other lessons learned over the centuries may be grouped in several well-defined patterns:

1. The higher the dikes, the higher the floods. The "critical level" has been calculated very accurately for many years by using mathematical tidal equations.

2. Many of the cities of Holland are built on wooden piles. Submerged in water, the piles have sustained their loads for centuries. Whenever reclamation work results in drainage, water tables drop and the tops of the piles rot. Hence the ground-water level must be controlled artificially.

3. As mentioned previously, the dikes along the branches of the Rhine and the Maas have caused the river bottom to silt up, resulting in a series of disasters throughout the centuries.

4. Differences in the densities of salt and fresh water have caused residual bottom currents from the sea landwards, choking the river mouths and opposing the release of river sand into the sea.

The remedy for the last two difficulties has been a common one—the dredge.

A research bureau was organized in 1931 to study these and associated problems; it chose for its first project the collection of sounding charts for the work that had been conducted for periods of up to two centuries. The charts afford a clear concept of the development of tidal channels. Other research has involved the use of sand traps, tide meters, echo sounders, grabs and drills. Echo sounders in particular have been of great value, permitting depth recordings of high accuracy. Another important program is concerned with prevailing currents and with sand and mud movements.

Mathematical research in Dutch reclamation is simplified greatly by the use of modern calculators and computers. To simulate the action of tidal currents electrically, the network of tidal rivers is represented in the form of copper wires, condensers, resistances and self-inductors, which permit accurate solutions to be given at the high frequency characteristic of such devices. The height of high or low water and the river currents at any point are measured electrically or shown visually by means of a cathode-ray tube. Hence calculations are made in advance to predict the results of river improvement work.

The large and well-equipped hydraulic laboratory at Delft is under the able supervision of Prof. J. T. Thijssee. There the greatest contributions have been made through the use of models at the largest possible scales. Typical problems include the effects of adverse wave action or silting on harbors, the height of wave action on dikes, the movement of sand, and the streamlining of river banks.

An excellent discussison of the general problem of reclamation from the Dutch point of view is to be found in the book, *Dredge, Drain and Reclaim*, by Dr. Johan van Veen, Chief Engineer, Rijkswaterstaat, The Hague, published in that city in 1955 by Martinus Nijhoff. Material from this reference work and from other sources has been condensed and used freely in the preparation of this review. A clearer insight into the problems presented was gained through personal interviews with Prof. J. T. Thijssee, and inspection tours made with Prof. W. F. C. van Bevervoorde, both on the faculty of the University of Delft.

# Modern water-well construction in California

**ROSCOE MOSS, Jr.,** Engineer, Roscoe Moss Company, Los Angeles, Calif.

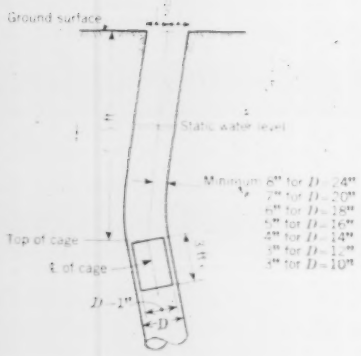



**FIG. 1. Well casing should be installed so that deflection from the vertical does not exceed 6 in. per 100 ft. At bends the pipe wall should not be closer than indicated to a line centered at top of casing, and held as shown.**

**FIG. 2. Double-wall well casing, with starter section at left and casing as installed at right.**

The water well is widely considered as little more than a hole in the ground rather than as an engineered project. This idea however is changing. In California the enormous underground reserves have been developed to such an extent that over half the total water consumed is derived from this source. In recent years more and more emphasis has been placed on engineering procedures and specifications to insure satisfactory operation of the well installation. These are summarized for high-capacity wells (a minimum diameter of 12 in.) in California alluvial formations.

## Cable tool method

The cable or percussion-tool method is used for drilling most high-capacity water wells in California. The bore hole is produced by the pulverizing action of reciprocating drill tools. Casing is carried more or less along with drilling to maintain the walls of the bore hole.

Four factors must be considered in designing a cable-tool-drilled water well-hole alignment, casing requirements, perforation, and development.

**Hole alignment.** The Salt River Valley Water Users' Association of Phoenix, Ariz., has established a standard that appears to represent the most practical answer to the problem of hole alignment for pump installation and operation. Briefly:

"The well shall be drilled in such vertical alignment that a line from the center of the well casing at the ground surface and the center of the well casing (?) ft below the ground surface shall not deviate from the vertical more than 6 in. in 100 ft of length, and at any bends shall be no closer to the inside wall of the casing than is shown by Fig. 1."

**Casing requirements.** Casings fall into two general classifications—single-wall and double-wall. Single-wall casing is generally restricted to shallow, low-capacity wells of less than 12-in. diameter or where an open hole can be drilled before the casing is installed. Double-wall casing has proven to be more satisfactory where jacking pressures up to 350 tons and heavy driving forces are frequently required to force the casing to the bottom of the hole.

The double casing, Fig. 2, is made up with the inside and outside circumferential seams staggered. The joints thus formed give much greater dependability than that possessed by butt-welded casing. The casing is normally made up in increments of 4 ft for flexibility under varying conditions. In addition, double-wall casing is fabricated from a high-tensile corrosion-resistant steel to withstand the rigors of drilling. Table I presents the chemical composition and physical properties of the steel employed in the manufacture of double-wall casing.

Specifications for double-wall casing are generally set up as follows:

"A starter shall be used composed of at least (?) ft of (?) in. No. (?) gage 2-ply 'kai-well' steel and shod with a bit steel shoe not less than (?) in. dimension. The double-wall casing shall be (?) in. internal diameter (?) gage 'kai-well' steel. The casing shall be welded with automatic equipment by a process that provides a weld of approximately the same tensile strength as the parent material and ductile in character. After the inner and outer joints of the casing have been welded they shall be pressed to exact fit so that the inner casing shall fit to the outer casing with a tolerance not to exceed 0.010 in. After the casing has been pressed to exact fit, the ends shall be lathe trimmed square to the axis so that the ends when placed together shall fit snugly for the entire circumference. The casing shall be so fitted that the lap shall be substantially one-half the length of each joint."

The diameter of the well casing is generally 2 in. larger than the nominal diameter of the pump bowls to be installed. The physical dimensions of the well pump are a function of demand requirements and anticipated well capacity. Casing-wall thickness is a function of formation characteristics, casing diameter, depth of well, and required longevity. Table II gives recommended thicknesses for double-wall well casings, as functions of depth and diameter.

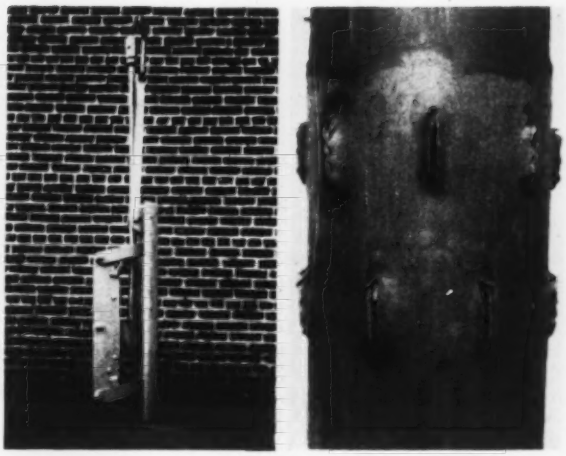


FIG. 3. Mills knife makes perforations in pipe underground, as shown at right.

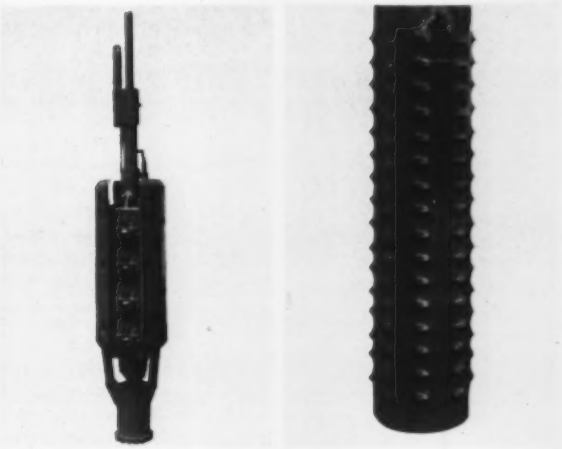


FIG. 4. Hydraulic louver-type perforator produces the preferred horizontal openings.

**Perforations.** The cable-tool well is not normally a gravel-packed well. Extreme care and attention must be given to logging the exact depths of existing aquifers so that a program of perforating the casing can be selectively designed to tap aquifers, which can be developed to form a natural screen at the perforations. The ability of perforations in the casing to permit maximum flow of water while preventing the flow of fine materials into the well is a prime consideration. These perforations must be made at selected depths in the well after the casing is installed.

The Mills knife and hydraulic louver-type perforators are most commonly used in California. The Mills knife is a mechanically operated perforator that produces a vertical opening about ½ in. wide and 5 in. long (Fig. 3). The hydraulic louver type of perforator produces a louver-shaped aperture facing downward (Fig. 4). The aperture varies in length from 2 in. to 2½ in. and in width from ⅛ in. to 5/16 in.

The presence of highly productive aquifers in many California basins composed of fine gravels and coarse sands requires a perforation that can effectively control the pumping of fine materials. The horizontal louver perforation most effectively meets this requirement. This opening has three advantages over the Mills cut:

1. Superior physical characteristics are imparted to the casing.

2. The hydraulically operated perforator permits a more precise control of aperture size.

3. The louver-shaped opening achieves much greater stabilization of particles in fine formations. From Fig. 5 it is evident that, with a vertical opening, a large number of small particles must bridge together in the vertical (critical) plane. With the horizontal opening only a relatively few particles are required for stability. The overhanging lip of the louver prevents material from running into the well (Fig. 6). Sands or silts, in order to move through the aperture, must flow upward along the angle of repose established by the louver.

There are limitations, however, in the use of these perforators for screening fine materials. The smallest practical openings are ⅛ to 5/32 in. and fine sands and silt, when not intermingled with coarser particles, must be stabilized with an artificial gravel pack.

After perforating, and before test pumping, the well is swabbed to remove fine material from the casing perforations and the well itself. This operation cleans the face of the aquifers, permitting efficient well development and production. Swabbing consists of reciprocating a plunger-type tool in the casing opposite perforated areas. This operation causes the water in the well to be flushed through the perforated casing and out into the formation.

## Rotary drilling method

Drilling by the hydraulic rotary method requires a cutting tool (bit), rotation of the tool, means for maintaining the pressure of the bit against the material being cut and a medium for removing the material displaced by the bit. With this method of drilling, the walls of the bore hole are kept open by pressure created by a circulating mud fluid.

For the construction of rotary-drilled gravel-envelope wells, certain basic procedures have been developed which must be followed to consistently achieve satisfactory results.

**1. Pilot bore.** The final bore is normally 24 to 28 in. in diameter and cannot be economically drilled in one operation. A pilot bore 12 to 15 in. is drilled first and serves as a means of securing information required for establishing the casing program. The pilot bore must meet alignment specifications to its full depth to permit proper casing installation and pump operation.

**2. Conductor casing.** Casing must be installed for some distance below the ground surface to establish a stable foundation and seal off any contaminating surface waters. It is common practice to grout the annulus between conductor and bore hole under pressure from the bottom of the hole with a neat slurry weighing about 115 lb per cu ft.

**3. Final bore.** The final bore should be opened out to a diameter about 12 in. greater than that of the well casing to provide sufficient annulus to permit installation of an adequate gravel envelope.

**4. Well casing.** A typical installation consists of an upper section of blank casing with an inside diameter 2 in. larger than the pump diameter and lower screen casing. This diameter is a function of the anticipated well capacity. The well casing must be suspended in tension from the conductor and suitably guided so that it will be centered at all joints in the bore. If the casing is allowed to rest on the bottom the resulting buckling will cause it to make contact with the walls of the bore hole.

Single-plate well casing is generally manufactured in accordance with American Waterworks Association Specification C-201 for 30-in. diameter and larger, or AWWA Spec. C-202 for smaller than 30-in. diameter. Steel plates employed in the manufacture of the

casing conform to ASTM A-283 Grade B, or ASTM A-242 if high tensile corrosion-resistant steel is required. Table III presents recommended casing thicknesses as functions of depth and diameter.

**5. Gravel envelope.** Practical experience has determined that a finely graded gravel envelope is required to properly control the pumping of fine sands and silts. This gradation should fall roughly within the following limits:

| Percentages Passing Screens Nos. | | | | | |
|---|---|---|---|---|---|
| ⅜ in. | 3 | 4 | 8 | 16 | 30 |
| 100 | 90-100 | 65-80 | 10-20 | 1.0-0.5 | 0 |

Most gravel companies produce a reasonably well rounded material with a gradation approximating the above. Under no circumstances should crushed material be installed in a well. There have been instances where the installation of crushed rock has resulted in reduced well production.

The most commonly employed gravel installation system is shown in Fig. 7. Two swabs mounted on the drill stem cause the circulating fluid to flow up the annulus. Water is introduced into the system and the mud weight in the annulus is reduced to not more than 68 lb per cu ft. Gravel can be introduced against the circulating stream at the surface or pumped through tubing into position at the bottom of the hole.

If blank casing extends to depths greater than 400 or 500 ft, gravel should be pumped in through the tubing. Consolidating the gravel envelope becomes more difficult when long sections of blank casing are installed. Under normal conditions, however, satisfactory results have been consistently achieved by careful installation of gravel from the surface. The circulating stream serves to remove any fine materials from the gravel and to prevent possible bridging.

**6. Well screen.** Discussion of the various types of well screens requires, first, the determination of criteria for establishing proper zones of perforation. One school of thought contends that perforations should be located only at the water-bearing strata. An accurate well log is required in order to properly perform selective perforating. Usually rotary well logs are not sufficiently reliable for this because of: (1) delay in the return of cuttings to the surface, (2) variation in the rates of cutting return depending on particle size and shape, (3) sloughing of a formation into the circulating stream, and (4) the pulverizing action of the drill bit. Electric logs have been utilized as an aid in determining the boundaries of production zones but results have been marginal because of improper interpretation and the many parameters that determine potential and resistivity readings.

Even if all production zones could be accurately located, selective perforating is still undesirable because gravel has a marked tendency to bridge just above the top of the screen. This leaves a cavity in the upper section of the screen, permitting uncontrolled flow of fine materials into the well. The gravel envelope can be consolidated by swabbing, but the control of gravel movement behind blank casing is difficult to achieve. If alternating sections of blank and screen casing are installed, the difficulties in maintaining the necessary control of the gravel filter are compounded. The advantages achieved in employing a continuous screen with maximum control over gravel movement and production from all zones more than offset any savings realized from reduced screen length.

Because a finely graded gravel envelope is required for obstruction of sands and silts, it becomes imperative to design a screen that will establish proper stabilization of the gravel as well as permit maximum flow of water. Experience has shown that a ⅛ to ⅜-in. opening is a practical minimum size. Smaller openings have been attempted but many have become sealed off as a result of corrosion or the wedging of fine particles in the opening. Approximately 50 percent of the gravel particles in the specified gravel envelope will pass through a ⅛-in. opening.

It is evident then that the shape and

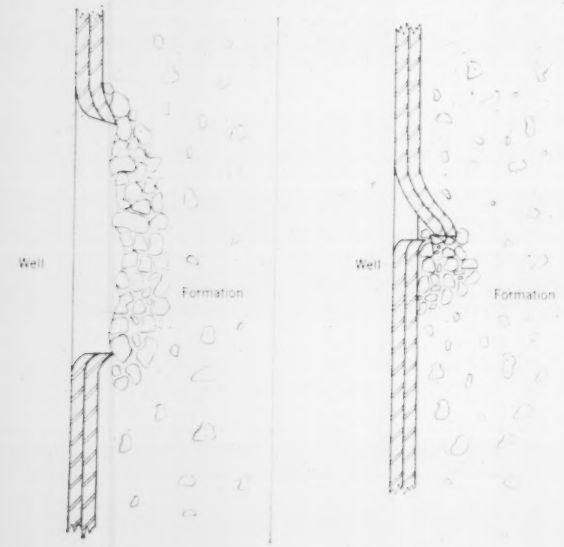



**FIG. 5. Typical gravel screens are formed around casing perforations — left, at a vertical cut: right, at a horizontal louver.**

**TABLE I. Properties of steel for double-wall well casing**

*Chemical Composition*

| Element | Limiting Chemical Range % | Typical Composition % |
|---|---|---|
| Carbon | 0.20-0.30 | 0.24 |
| Manganese | 0.85-1.15 | 0.95 |
| Phosphorus | 0.05 max. | 0.037 |
| Sulphur | 0.05 max. | 0.031 |
| Silicon | 0.12 max. | 0.09 |
| Copper | 0.20 min. | 0.27 |

*Mechanical Properties (ASTM Standard Methods)*

| Property | Expected Range | Typical Value |
|---|---|---|
| Yield strength, psi | 55,000-70,000 | 61,300 |
| Ultimate strength, psi | 80,000-95,000 | 86,200 |
| Elongation, % in 8 in. | 17-25 | 22 |
| Rockwell "B" hardness | 80-90 | 86.5 |
| Elastic ratio | 69-73 | 71 |

**TABLE II. Minimum thickness recommended for double-wall well casing**

*(Double thickness of gage number listed)*

| Inside Dia. | Depth, in Feet 100 | 300 | 500 | 750 | 1,000 | 1,500 | 2,000 |
|---|---|---|---|---|---|---|---|
| 12 in. | 12 | 12-10 | 10 | 10 | 10-8 | | |
| 14 in. | 12 | 10 | 10 | 10-8 | 10-8 | | |
| 16 in. | 10 | 10 | 10-8 | 10-8 | 10-8 | 8 | |
| 18 in. | 10 | 10 | 10-8 | 10-8 | 10-8 | 8 | 8-6 |
| 20 in. | 10 | 10-8 | 10-8 | 10-8 | 8 | 8 | 8-6 |
| 24 in. | 8 | 8 | 8 | 8-6 | 8-6 | 6 | 6 |

**TABLE III. Minimum thickness recommended for single-wall plate casing, inches**

| Inside Dia. | Depth, in Feet 300 | 500 | 750 | 1,000 | 1,500 | 2,000 |
|---|---|---|---|---|---|---|
| 12 in. | 5/16 | 1/4 | 1/4 | 1/4 | 5/16 | 5/16 |
| 14 in. | 5/16 | 1/4 | 1/4 | 1/4 | 5/16 | 5/16 |
| 16 in. | 1/4 | 1/4 | 1/4 | 5/16 | 5/16 | 5/16 |
| 18 in. | 1/4 | 1/4 | 5/16 | 5/16 | 5/16 | 3/8 |
| 20 in. | 1/4 | 5/16 | 5/16 | 5/16 | 5/16 | 3/8 |
| 24 in. | 5/16 | 5/16 | 5/16 | 3/8 | 3/8 | 3/8 |

orientation of the perforation is extremely important. As previously noted, a vertical slot cannot stabilize fine particles. A horizontal slot will establish the required stability but has one drawback in that the finer particles have a tendency to bridge and clog in the slotted opening. The louver-shaped or shutter-screen perforation presents an orifice that has non-parallel surfaces. This in large measure solves the plugging problem and has the added advantage of being 20 to 30 percent stronger in radial compression than the slotted screen. The downward-facing aperture provides for maximum control of the gravel envelope.

**7. Drilling fluid.** Reasonable control of the drilling-mud weight, viscosity and filter loss should be exercised during operation to prevent excessive wall cake and fluid loss into the formations. All drilling mud must be removed from the annulus before gravel installations in order to prevent blocking of the aquifers.

**8. Preliminary development.** After the gravel envelope has been placed, the well must be thoroughly washed and swabbed with the rotary rig. Water should be added continuously to the circulating system so that mud and fine materials swabbed into the system can be disposed of.

Because of its operating characteristics, a rotary rig cannot swab as effectively as a cable tool rig. With proper operation a cable tool rig can locate tight zones or cavities and, by giving the swab a reciprocating motion, can bring in material and move or consolidate the gravel. It has become standard practice in some areas to perform initial development work on all rotary-drilled wells with a cable-tool rig before installation of the test pump.

Development work performed with the turbine pump is as important to final well performance as the drilling of the well itself. By and large, because the drilling of a cable-tool well is performed without mud and the aquifers are selectively perforated, there are fewer problems in developing a well of this type. As development proceeds, a natural gravel pack is formed around each perforation by the removal of fine materials near the face of the aquifer.

Great care must be exercised in the development of a gravel-envelope well. Mud and fine particles must be removed from the face of the aquifer. At the same time, excessive material must not be pumped, for this will produce cavities with resulting discontinuity of the gravel envelope.

There are a few rules for development and test pumping. The pump should have greater capacity than the expected working production so that the well can be conservatively operated at less than its developed capacity. The pumping should be started at a low rate and each step in the development carefully observed. Because of the presence of mud and fine particles the well, initially, will pump a relatively small quantity of water. As the water clears, backwashing and surging is commenced. This loosens and removes materials that are blocking the flow of water and the specific capacity increases. As this operation is repeated, the time required for the water to clear will become shorter.

Ideally, when development is complete, the well should be capable of being surged without subsequent production of objectionable quantities of sand and silt. When testing for maximum yield it is imperative that sand production be checked with a reliable measuring device, because, with most wells, the flow of sand rises rapidly beyond a given capacity. This is due to the fact that excessive pressures or velocities produced in the aquifer can lead to small movements of fine materials, which cause localized breakdowns in the filter screens. If final production is maintained below the velocity that produces this movement, the chances of developing operating difficulties are slight.

## Conclusions

A primary consideration in selecting the method of drilling for a given well is construction cost. Other factors being equal, the cable-tool method is more economical down to about 1,500 ft. This is particularly true with large-diameter bores where difficult drilling conditions are encountered. With wells to depths of 2,000 ft and greater, where the formations encountered consist mainly of fine gravels, sands and clay, the higher penetration rates achieved by the rotary machine tend to offset its higher operating cost. Many relatively inexpensive rotary wells are drilled, of course. However, costs sometimes are reduced through the installation of lightweight and less durable casings and by questionable construction practices. Such economies frequently result in considerably reduced well life.

Generally, cable-tool methods of well construction continue to predominate in areas where aquifers are coarse and fairly well defined. Recent production tests comparing gravel-envelope and non-gravel-envelope wells run in an area of this type indicated no difference in specific capacity between the two types. In fact, a slightly higher yield was obtained from one of the non-gravel-envelope wells. Sand production was about the same for all.

There are some areas where, regardless of cost, gravel-envelope wells must be constructed. Such an area would be one containing many aquifers composed of fine sands and silts, which cannot be naturally screened off with a standard perforation screening. An artificial gravel pack is required in such circumstances to permit proper development and control of the producing lenses.

Careful consideration must be given to many factors when choosing the method for drilling a particular well. Cost, production, characteristics of aquifers, and other factors must be evaluated before making a decision.

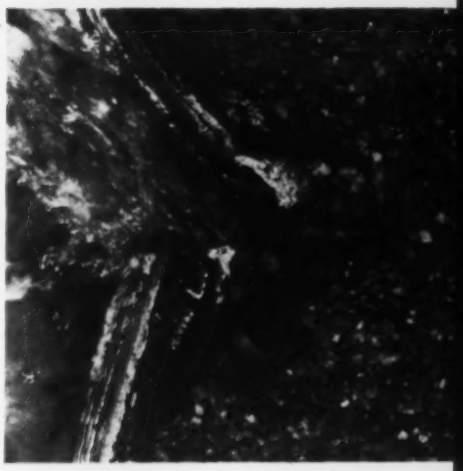


**FIG. 6. Gravel forms a bridge at a horizontal louver perforation.**

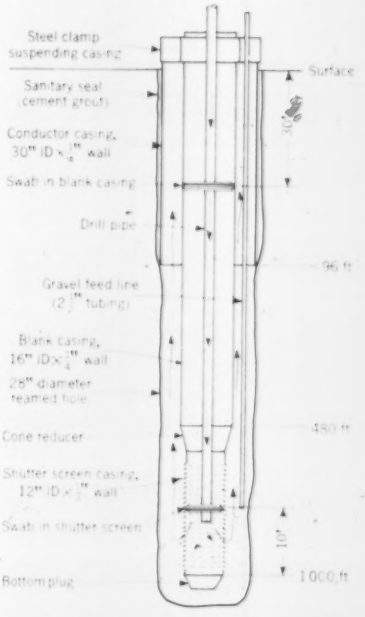



**FIG. 7. Well drilled by rotary method is kept open by drilling "mud," and the annulus outside the casing is filled with gravel to form a screen.**

# Passamaquoddy—

# Power from the tides?

**ALDEN K. SIBLEY, M. ASCE,** Brig. Gen., Division Engineer, U. S. Army; Engineer Division, Corps of Engineers, New England

The world's ever-increasing consumption of power calls for a serious appraisal of all potential energy sources. Today this search is spurred on by estimates of the Federal Power Commission that our use of power in 1980 will be four times present consumption. Furthermore it has been predicted that at the average rate of energy consumption in the next one hundred years, less than a ten-year supply is available from known conventional sources throughout the world. Our own survival as a free nation and that of the free world may well depend on the vision and skill with which we meet our power needs in the next decade.

In an era when the need for energy has never been so great, nor the exhaustion of conventional sources of fuel so imminent, man can scarcely afford not to examine all possible sources of low-cost energy. Symbolizing today's search for new power sources to meet tomorrow's demands is the $3,300,000 engineering investigation of the possibility of generating electric power from the tides in the Bay of Fundy. Inaugurated three years ago by the Canadian and United States governments, the investigation is now in its last year, after which recommendations to the two governments as to the feasibility of the project will be made by the International Joint Commission.

The U.S. Army Engineer Division, New England, through the Passamaquoddy Survey Division, is conducting the engineering investigations here outlined in collaboration with the Federal Power Commission, the New Brunswick Electric Power Commission, the Department of Public Works and the Department of National Resources and Northern Affairs of Canada, and other agencies of the State of Maine and of the provincial and federal governments. Because many aspects of the survey have not yet been reviewed by the Passamaquoddy Engineering Board and Committee, nor reviewed by the International Joint Commission, the writer's present summary should not be construed as prejudging any of its specific findings or general conclusions.

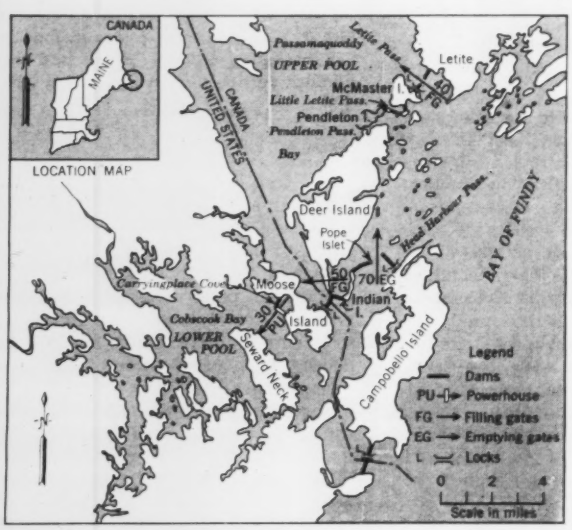
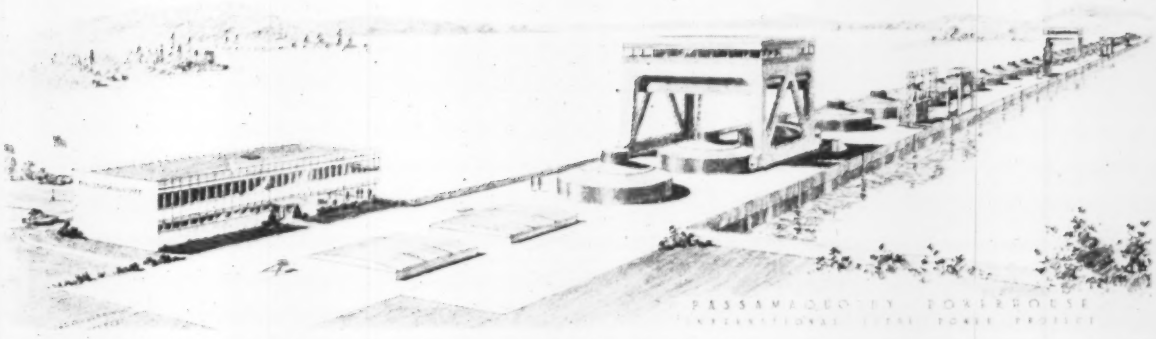



**FIG. 1. In plan of Passamaquoddy Tidal Power Project selected for detailed design, Passamaquoddy Bay acts as upper pool and Cobscook Bay as lower pool. Number of generating units and number of gates are marked in each location and symbols are defined in legend. Arrows indicate direction of flow.**

Tidal power, similar to other types of hydro power, can be produced by passing water from a higher to a lower elevation through hydraulic turbines. In this way the tides can produce power unaffected by droughts, floods, ice-jams, or silting, which decrease the output and limit the life of river hydroelectric plants. Moreover, ocean tides, dissipating their energy continuously at the estimated rate of 2 billion horsepower, constitute the most dependable continuous source of terrestrial energy and, unlike the flow of rivers, can be predicted with accuracy.

It is axiomatic that where the tides are highest, the potential power source is greatest. In Minas Basin and Chignecto Bay in Canada, at the head of the Bay of Fundy, the tides reach an extreme range of 60 ft. Passamaquoddy tides near the mouth of the Bay of Fundy range from about 12 ft at neap tide to 26 ft at spring tide, with an average range of 18.2 ft. About four billion tons of water flow into and out of Cobscook and Passamaquoddy Bays twice each day. This is nearly equal to the average two-week flow of the Mississippi River below the mouth of the Red River above New Orleans—the accumulated runoff from almost half the three-million-square-mile land area of the United States. If only a fraction of this great volume of water could be harnessed to drive turbines, the power produced would be impressive.

The principal disadvantage of harnessing tides is that the tide reverses its direction four times a day. To devise a workable and economically feasi-



**Outdoor powerhouse proposed for Passamaquoddy Tidal Power Project is seen in architect's rendering. It has two erection bays at each end and two large traveling gantries for erection and maintenance of turbines and generators.**

ble method of producing continuous power from such a varying flow constitutes the prime engineering challenge of tidal power production.

Of the many ways of producing power from the tides, all require one or more storage pools if large amounts are to be generated. A single pool can store water at high tide and discharge through turbines to the ocean at low tide, or it can be emptied at low tide to receive the turbine discharge during high tide. Two separate pools may be used, one filled at high tide and the other emptied at low tide, with the high pool discharging through the turbines into the low pool. Various combinations of these methods alone or augmented by a pumping cycle can be used. Two conditions must nevertheless be met for economical power production: the tidal range must be great enough to run the turbines, and the topography must permit the economical construction of pools. The Passamaquoddy-Cobscook Bay areas in Maine and New Brunswick fulfill both conditions by providing a fortuitous combination of large natural bays on a coast where high tides occur.

A number of schemes involving both single and double pools were analyzed to determine the method of operation best suited to Passamaquoddy and Cobscook Bays. Before the best project layout could be selected, however, it was necessary first to conduct basic field investigations including deep and shallow water drilling, land drilling, geophysical exploration, analysis of soils, and tide gaging. Among the most costly and difficult undertakings of the survey were the deep-water drilling at great depths and high tidal velocities, and the geophysical exploration employing newly developed sonic equipment.

By deep-water drilling earth and rock core samples were taken at selected points in the bottom of the bays. These were used to determine the optimum design and location of the powerhouse, navigation locks and high, rock-filled dams. Facing the unprecedented task of core drilling in waters 300 ft deep, swept by reversing tidal velocities of up to 6 fps, Brown and Root Marine Operators, Inc., of Houston, Tex., brought from the Gulf Coast a 240-ft barge equipped with a drilling assembly designed specifically for this job. A Failing 1500 drill rig with a 38-ft mast was mounted on a General Motors diesel truck located on a specially constructed drill platform 26 ft above barge deck.

Horizontal alignment of the drill column was maintained through continuous control of four 1¼-in. steel anchor cables attached to individual winch drums. Drilling was performed through a 30-in. conductor pipe extending from barge-deck level to near water bottom. This large pipe substantially reduced the effects of transverse tidal currents on the long string of drill rods. With this equipment a total of 15 carefully selected deep-water borings and 6 shallow borings of undisturbed overburden and bedrock samples were secured for analysis. Technical properties of foundation soils were determined in the field office laboratory in Eastport, Me., operated under contract by Greer Engineering Associates, Montclair, N. J.

Equally as challenging as the deep-water drilling was the use of highly specialized sonic fathometer equipment to chart the bays and to correlate deep-water borings. The Geophysical Division of the Fairchild Aerial Survey Corporation of California was engaged to chart the bottom in Passamaquoddy and Cobscook Bay and determine the nature and depth of overburden. Investigation was made with the Marine Sonoprobe developed by the Magnolia Petroleum Company of Dallas, Tex. This instrument emits a high-energy audio-frequency signal designed to penetrate under-water sediments and to record echoes from interfaces of overburden and bedrock.

It was found that the Sonoprobe could not distinguish between rock and gravel; it could, however, distinguish marine clays. Since both rock and gravel would furnish an adequate foundation for rock-filled dams, the Sonoprobe gave valuable information by delineating areas of unsuitable clay bottom.

Data from these field investigations permitted a relatively precise comparison of some 60 possible project arrangements.

The criterion for the best tidal project arrangement is that it should provide the maximum amount of energy (kwhr per year) at the lowest cost. Each of the sixty possible schemes was tested against this criterion.

It soon became clear that while the single-pool plan and the "single high, single low" two-pool plan might produce more energy, they could yield only intermittent or interrupted power at higher cost than the simple two-pool arrangement with its continuous power production.

In broad outline, the project arrangement selected for detailed design includes the 100 square miles of Passamaquoddy Bay as the high pool, and the 38 square miles of Cobscook Bay as the low pool. The powerhouse would be at Carryingplace Cove, as shown in Fig. 1. The total length of earth and rock-filled barriers is about 28,000 ft, with a depth in some areas as great as 300 ft below mean sea level. In this arrangement 90 filling gates are incorporated in the barriers across Letite Passage and at Deer Point, and 70 emptying gates in the barrier between Pope Island and Green Island. Barriers at Quoddy Roads, and between Moose

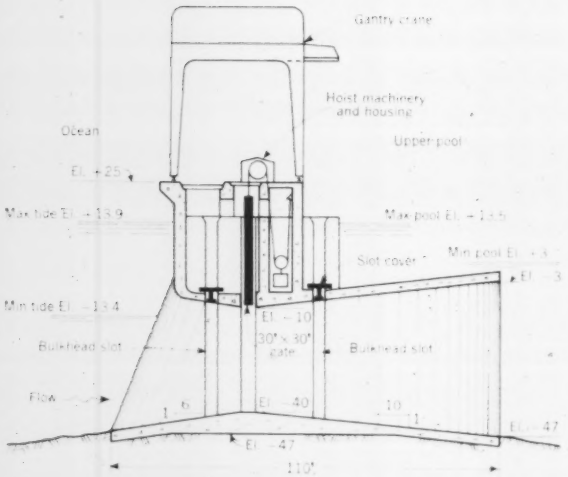



**FIG. 2. Vertical-lift filling gates set in submerged venturi throats were selected for chosen scheme. Venturi throat permits maximum velocity head and discharge rate for a given gate area. There would be 90 gates, each 30 ft X 30 ft.**

Island, Deer Island Point, and Indian Island closed the lower pool.

The selected two-pool project would generate about 1.9 billion kwhr a year using thirty 10,000-kw generators. Generation would thus be 6,000 kwhr per year per kilowatt of capacity. Average use of each kilowatt of capacity would be about 69 percent. Operation of this project would be continuous, and some capacity would be available at all times.

**Tidal dams.** The construction of some five miles of rock-filled dams in channel depths of 300 ft with reversing, 5-knot tidal currents poses engineering problems without precedent. The difficulties of closing the barriers in the face of restricted and greatly increased velocity heads, and the incorporation of enough gravel and fines with the derrick stone to make a tight structure, appeared at first to be insurmountable. Construction methods and causes of recent foundation failures in the Great Salt Lake causeway for the Southern Pacific Railroad were studied, and hydraulic model tests are currently being conducted by Dr. Lorenz G. Straub at the University of Minnesota. Although Dr. Straub's studies are not yet complete, it appears from preliminary analysis that the dams can be built with conventional marine and land equipment.

To overcome the problem of augmented tidal velocities during construction, dam construction can be programmed so that filling and emptying gates would handle part of the tidal ebb and flood. How the dams can be made sufficiently watertight to avoid power loss is another difficulty not yet resolved. Although some 18 million cu yd of clay must be excavated in the forebay of the powerhouse, it does not appear possible to use this clay as an integral part of the rock-filled dam since there is apparently no method available for compacting it under water.

**Filling and emptying gates.** The selected plan calls for 90 filling gates, 40 in Letite Passage and 50 at Deer Island Point, as shown in Fig. 1. Comprehensive study of all types of gates, leading to detailed examination of nine of the most feasible, led to the selection of a 30-ft x 30-ft vertical-lift gate set in a venturi throat, as illustrated in Fig. 2. The venturi throat permits maximum velocity head and discharge rate for a given gate area. To avoid icing, the gates are set low enough to inundate the upper-pool side permanently and the ocean side at all times except at extreme low tide.

In the reach between Polk and Green Islands, 70 emptying gates, similar to the filling gates but set at a lower elevation, will empty the lower pool. The cofferdams required for construction of filling and emptying gates, as well as for the navigation locks and the powerhouse, will be subjected to heads as high as 60 ft, whereas the heads on the completed structures will not exceed 26 ft. A special study now under way indicates that the problem of cofferdam construction, although challenging, will not prove insurmountable.

**Navigation locks.** Four navigation locks are planned for the selected tidal project. Two sets of locks at Letite Passage and Quoddy Roads at the extreme north and south limits would have clear dimensions of 95 ft x 25 ft x 10 ft to pass smaller fishing vessels. Two sets of locks at Head Harbor Passage, immediately east of the emptying gates, and at Western Passage to the north of Eastport, would have clear dimensions of 415 ft x 60 ft x 21 ft to pass vessels somewhat larger than those employed in the present traffic.

Reversing head on the locks ruled out miter gates in favor of sector gates, which have proved successful at numerous locks where a similar head reversal occurs, on the Intracoastal Waterway in the Gulf of Mexico and on the Sacramento River. The sector gate was thoroughly tested at the Waterways Experiment Station at Vicksburg, Miss., for the Algiers Lock on the Intracoastal Waterway, Gulf Section, Louisiana. Locks can be filled through partly opened sector gates supplemented by short culverts in the gate monolith, a method particularly advantageous in the selected project. Long filling culverts will not be needed and wall construction in the rock cut, encountered to various depths at all lock locations, will be held to a minimum.

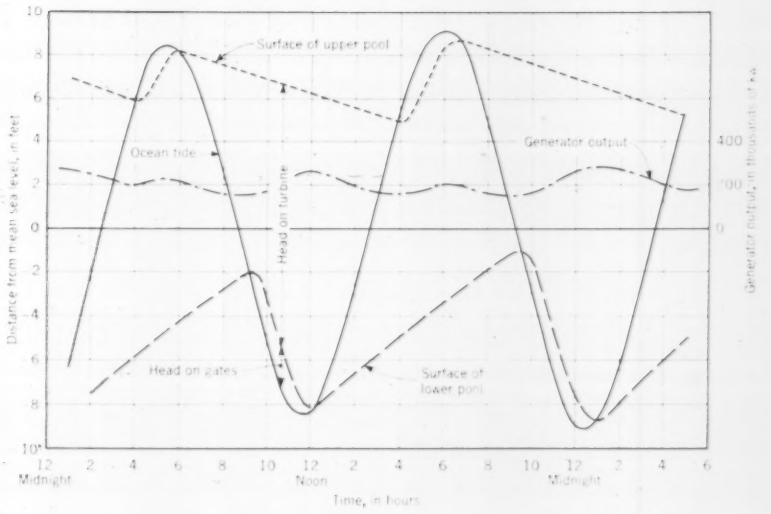
**Turbines.** The low average power head of about 12 ft in the selected two-pool project dictated the selection of turbines with a throat diameter as large as practicable in a powerhouse of minimum length to fit the available sites. Manufacturing specifications and other factors pointed to a maximum diameter of 320 in. and a minimum rotation speed of 40 rpm.

A new type of horizontal-axis turbogenerator recently developed in Europe, and adopted for use at the La Rance single-pool tidal project in France, was also studied for possible adaptation to the Passamaquoddy project, and recommended as more efficient than conventional units. Structural studies indicate that a saving of approximately $400,000 per powerhouse unit might be realized if this bulb-type unit were used, although this saving probably would be offset by the need to compensate for the low rotative inertia. For this reason, and because of the novelty of the bulb-type unit—only one such large unit has been extensively tested in the Massive Centrale—unresolved maintenance problems and other questions, the bulb-type unit was abandoned in favor of the conventional fixed-blade type for the purpose of evaluating project feasibility.

**Generators.** Generators rated at 10,000 kw, with a 15-percent overload capacity, direct-connected to 40-rpm turbines were selected in preference to larger and more costly generators.

The outdoor powerhouse, shown in the architect's rendering, has a total length of 2,340 ft, with two erection bays at each end and two large traveling gantrys for erection and maintenance of turbines and generators. All the control equipment is on the turbine-room floor below the top deck. The main transformers are on the upstream side of the powerhouse, connected to the switchyard at the far (north) end

**FIG. 3. Typical cycle of tidal plant operation shows how output of selected two-pool plan would vary with the ebb and flood of the semidiurnal tides.**




by oil-filled high-voltage cables. The 30 generators are connected to four output transformers, two operating at 230 kilovolts for supply to the United States and two at 139 kilovolts for Canada.

### Stabilizing tidal power

The problem of stabilizing the fluctuating power output is crucial to any tidal project. Figure 3 shows how the output of the selected two-pool project varies with the ebb and flood of the semidiurnal tides. Coupled with the variation from spring tide to neap tide and the 50-minute daily lag, this variable output contrasts sharply with the pattern of normal power demand, which follows the peak demands of the Monday-to-Friday work week. Unless a great deal of the tidal energy is to be wasted, the output can be modified only slightly to match the characteristic load pattern. Some way must be found to reconcile the differences between these two patterns. This problem, common to all tidal projects, admits of several possible solutions.

First, if tidal energy were fed into a sufficiently large power grid, as Electricité de France plans for the output of the La Rance Project, the remainder of the system could absorb the difference between the load and the tidal-plant output.

Second, tidal power could be operated in conjunction with a steam-electric plant. However, since the auxiliary output must vary rapidly from hour to hour, and since its energy output per kilowatt of capacity would be relatively small, a steam-electric auxiliary appears highly uneconomical.

Third, tidal power could be supplemented by a pumped-storage plant. Using power from the tidal plant at times when it is not required to meet load demands, water could be pumped to a higher storage basin and released through turbines as required to meet the load.

Fourth, the tidal plant could be operated in conjunction with a river hydro plant. Among a number of river sites examined, Rankin Rapids on the upper Saint John River has been selected as the best to use in combination with the tidal plant. By substantially reducing the gross cost of project power, Rankin Rapids appears to be by far the most promising and economical of the river sites available for a combined project.

The degree of economic justification of the Passamaquoddy Tidal Project will be measured by the ratio of annual costs to annual benefits. Benefits from the tidal power project will be determined by comparing its power cost with the cost of generating an equivalent amount of power by the cheapest alternate means, probably a steam-electric plant. The cost of a kilowatt of installed capacity and a kilowatt-hour of energy from the tidal plant will be compared to similar costs for an equivalent steam plant. Cheaper tidal-plant costs would support a favorable recommendation. Should the economic analysis prove favorable, that is, if Quoddy power with or without auxiliary power proves cheaper than steam-electric power in the area, it would still remain to determine whether present and potential power markets in Maine and New Brunswick could absorb so large a block of power were it available. Accordingly the New Brunswick Electric Power Commission and the Federal Power Commission have conducted power market surveys of the potential consumers of Quoddy Power in the Maine-New Brunswick areas.

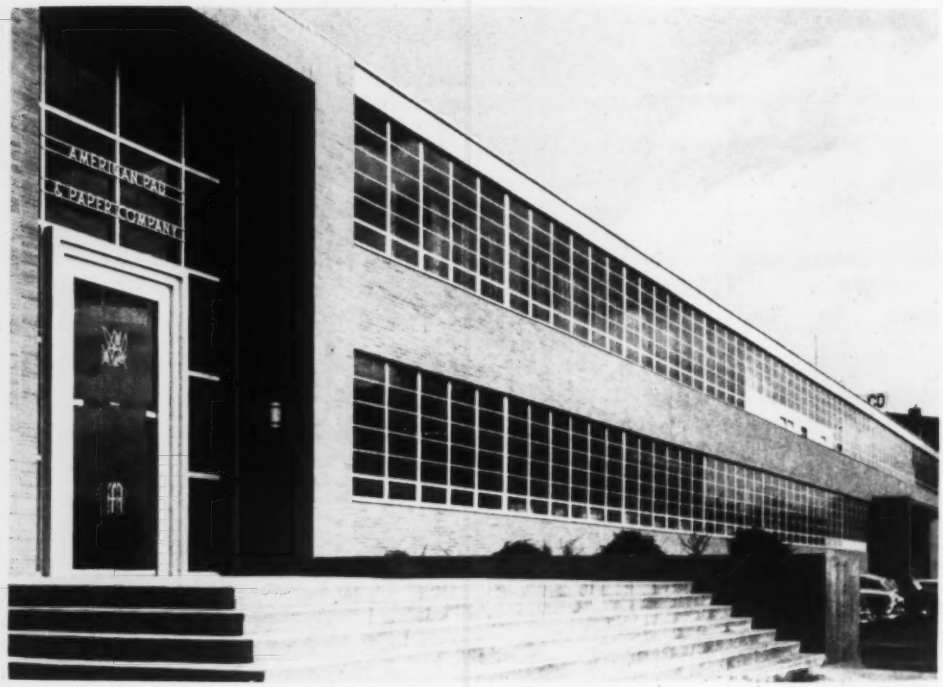
Over and above expansion of existing markets in the project area in Maine and New Brunswick, the possibility of attracting new industry must also be considered. One of the principal aims of this survey, which is yet to be completed and correlated with power-market studies, is to identify industries that might be attracted to the area by a new source of dependable power. Industrial development in the immediate vicinity would, of course, substantially reduce problems of transmission lines, auxiliary power, and load factors.

Thus the impact of the Passamaquoddy Tidal Power Project on all aspects of economic life in Maine and New Brunswick, including effects on commercial and sport fisheries and on the resonant structures of the tides themselves, is being studied in order to insure the most comprehensive and precise analysis possible.

In conclusion, the energy problem facing the world today, created by limitations of conventional and fission energy sources and the uncertainty of perfecting the thermonuclear fusion reaction for man's use, certainly demands careful consideration of generating low-cost energy from the tides. Although it is too early in the present survey to forecast what the recommendations of the Board and the International Joint Commission may be, the present investigation of the feasibility of taking power from the tides in Passamaquoddy and Cobscook Bays will solve problems that have intrigued engineers ever since Dexter P. Cooper, M.ASCE, made his first large-scale study in the early 1920's.

If the present study shows the Passamaquoddy project to be feasible as a source of low-cost power, the governments of Canada and the United States may once again cooperate in an international project for the equal benefit of both nations through construction of the first power project of any magnitude in the Western Hemisphere to harness the perpetual energy of the tides.

*(This article has been taken from the paper presented by General Sibley at the ASCE Annual Convention in New York, before the Waterways and Harbors Division session sponsored by the Division's Committee on Navigation and Flood Control Facilities, and presided over by Roger H. Gilman, chairman of its Executive Committee.)*




**Manufacturing and storage plant of American Pad and Paper Company at Holyoke, Mass., was built complete for $6.15 per sq ft.**

# *Engineered architecture—an approach to economical building design*

An irregular 4½-acre plot with a 25-ft difference in elevation has been developed into an unusual general office and manufacturing plant for the American **Pad & Paper** Company in Holyoke, Mass. Advantage was taken of the hillside to make a readily accessible two-story structure in which manufacturing activities are separated from storage and handling. Excavation was reduced by building the second floor over the high side of the lot only (Fig. 1).

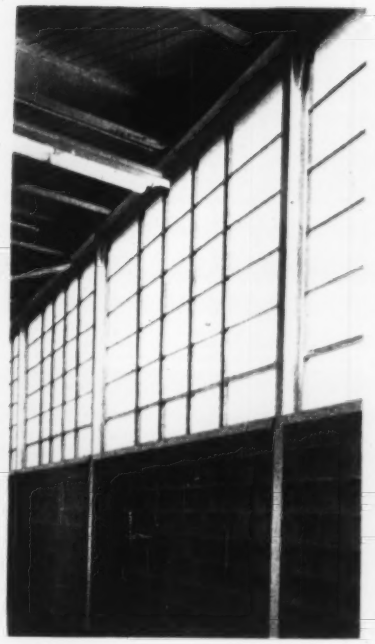
The unusual topography presented a number of problems in design, among them that of layout for economy of plant operation and that of overall size and shape of the building for economy of construction. The design was worked out to provide a partial two-story building, having about 45,000 sq ft on the lower level and about 70,000 sq ft on the upper level, a total of 115,000 sq ft.

In general, the first floor accommodates the warehousing and storage portion of the work. It has shipping and receiving areas for trucks and for railroad cars. The upper area (Fig. 2) is the factory proper, where most of the manufacturing processes are carried on. Here also are located the general and private offices, printing department, shop, and associated facilities. Material can be received at the first-floor level and brought up to the second floor by elevator, or it can be received directly on the upper level from the loading dock on Oneko Street.

Finished goods are taken to the lower or storage level by gravity roller conveyors and by power-operated conveyors. The clear height of the lower level is 15 ft while a 12-ft height is provided in the shop and manufacturing area. Column spacing on the lower floor is 16 × 24 ft; for the upper floor it is 32 × 24 ft to provide more open work space. The exterior of the building has continuous aluminum sash for both the lower and upper floors with face-brick spandrel walls. The entrance is a little more elaborately styled, using Indiana limestone and an aluminum entrance frame 29 ft high.

Soil in the area is generally good since hardpan underlies the entire site, usually only a few feet below the surface. Foundations were designed for a soil bearing of 6,000 psf but some had to be redesigned for half that load where the hardpan was deeper than expected. Slabs on grade were designed for 1,000 psf while the bearing slab of the second floor was designed for a live load of 200 psf and the roof for a live load of 30 psf.

The roof framing consists of 2-in.



Cinder block for back-up of spandrel walls, aluminum sash and steel framing make an economical building.

Concrete floor laid on the ground is designed for warehouse loads of 1,000 psf. Aluminum Holorib is inverted to serve as ceiling and form for second floor concrete. Fluorescent lights provide 30 ft-candles in all areas. Sprinklers here are of wet type.

**A. GEORGE MALLIS, M. ASCE,** Munson and Mallis, Inc., Springfield, Mass.

**RICHARD M. WEISER, Jr.,** Vice President, American Pad & Paper Co., Holyoke, Mass.

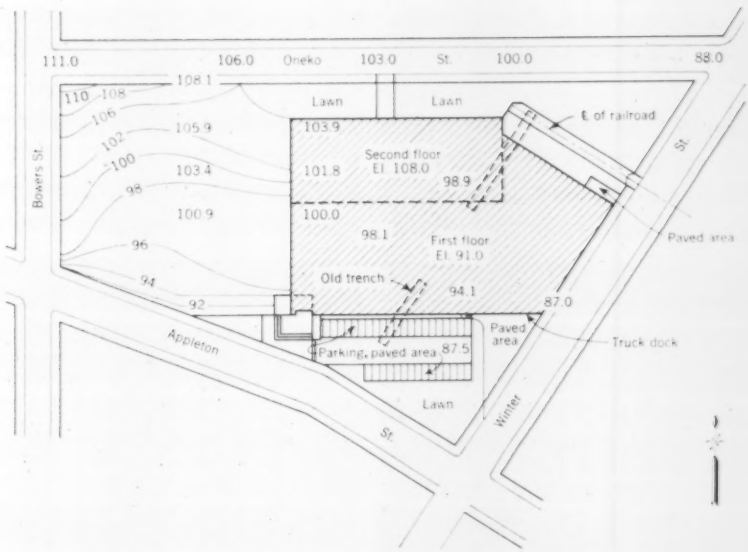



FIG. 1. Hilly site was adapted to paper processing by keeping manufacturing on upper level and storage below. Rectangle marked off by dashed lines was unexcavated at first-floor level.

tongue-and-groove planking, spanning 8 ft, supported on steel beams, which in turn are carried on steel girders. The wood plank is covered with one inch of insulation over which is applied a five-ply 20-year bonded Barrett roof. Suitable expansion joints (Fig. 3) are provided in the roof of the building. The entire roof is supported on lally columns, for both interior and wall columns.

The structural second floor consists of 3½-in. reinforced concrete on 20-gage galvanized Holorib reinforcing form using 4 × 12-in. 8/12 welded wire mesh in the concrete. The galvanized Holorib reinforcing form is welded to steel beams which in turn are supported on steel girders. The galvanized form is left exposed as the warehouse ceiling. Girders are supported by H-columns or lally columns, depending on whether they carry only the second floor or that floor and the roof, providing an economical solution for different loads.

There was a support problem where the upper floor extends over the unexcavated area. In general, the excavated material was hardpan so that the excavation provided minimum clearance

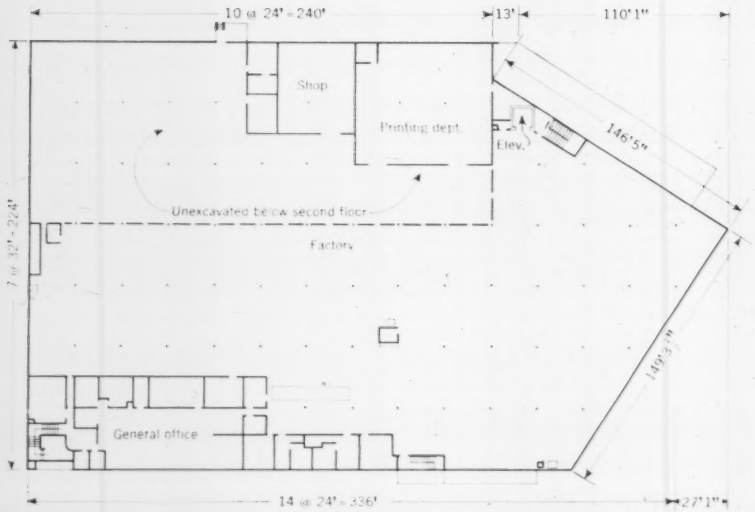



**FIG. 2. Printing and manufacturing are done on upper floor. Material moves by conveyor to lower level for storage and shipping.**

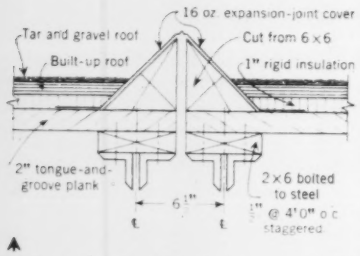



**FIG. 3. Detail of roof expansion joint.**

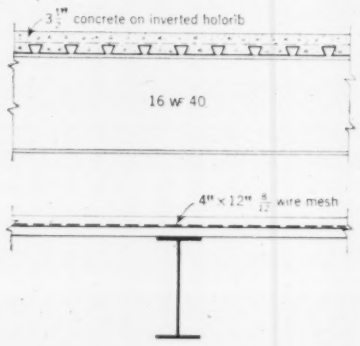



**FIG. 4. Detail of upper-floor construction over storage area.**

for the erection of forms and pouring of the wall. The backfill material was placed in 6-in. layers and mechanically compacted, with water added during placing. When possible, the compaction was done by heavy wheeled vehicles moving parallel to the wall. Steel dowels were placed in the top of the wall and tied into the floor steel. Sufficient steel was placed in the floor concrete to bridge from the vertical wall over the excavated space as a slab in case of differential movement. There has been no noticeable settlement.

Interior partitions in the manufacturing and storage area are economical cinder-block walls. The only exception is in the office area, where the partitions are wood stud with ⅝-in. Sheetrock and taped joints.

Ceilings are left exposed in all areas except in the general and private offices, where acoustical ceilings have been installed. Floors in all areas are 3,000-psi concrete, placed very dry and hardened with two coats of Lapidolith squeegeed on. It has thus far proved successful although there has been a small amount of dusting as a result of plant operations. The dust is removed by periodic washing. Offices have asphalt, rubber, or vinyl tile floor covering—depending on expected use.

The plant is located in a heavily industrialized area of Holyoke, where ample utilities are available. The building is sprinklered throughout, using a wet system in heated areas and a dry system in unheated platform areas. Toilet facilities for men and women are provided on the lower floor, and there are two sets on the manufacturing floor, plus additional facilities for men and women in the office section.

## Heat, power, lighting

Heating in general is by gas-fired space heaters, either ceiling suspended or floor mounted, depending on their size. The offices are heated with baseboard radiation and a separate air-conditioning duct system. Gas heaters range from a unit of 70,000 Btu to one of 750,000 Btu. While there is no air conditioning in the shop, a method of cooling has been provided which utilizes eight huge ventilating fans in one wall to move air in every part of the shop. These units operate at a very slow speed so that there is no noticeable motion of air to disturb the paper processing.

The electrical system provides secondary power of 550-volt, three-phase, 60-cycle type (selected to match existing equipment). Underground cables terminate in free-standing metal-enclosed switch gear of circuit-breaker type, using molded frame breakers of 25,000-amp interrupting capacity.

From this switch gear, conduit and cable feeders run to busways supported from ceiling joists. From these busways in turn, bus drop cables extend to all motors. This arrangement makes it easy and economical to relocate motors as production changes may require.

Lighting is fluorescent throughout, with 30 ft-candles provided in the shop area and 50 ft-c in office areas. Lighting is supplied through three-phase dry-type transformers. The neutral of all transformers is connected to the columns, and a ground grid (4/0) laid under the ground-floor slab connects to all columns and to the sprinkler system, providing good neutral grounding.

The building is provided with a completely supervised fire-detection system with a city call-in box, providing around-the-clock protection. In the office area, an under-floor duct system allows power and telephone outlets to be placed or relocated with a minimum of expense and effort.

Table I gives costs for component parts of the plant. It will be noted that the total cost—including site preparation, paving and planting—is only $6.15 per sq ft based on the building area.

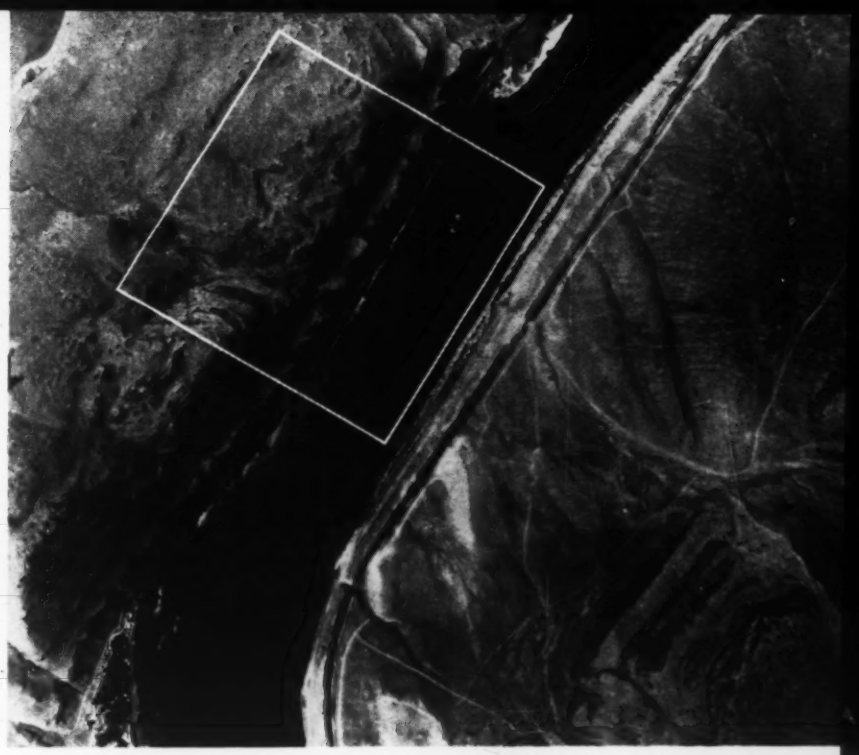
Architectural and structural design as well as supervision of construction was handled by the firm of Munson & Mallis, Inc., of Springfield, Mass. The mechanical consultant was D. T. McCarthy, and the electrical consultant E. M. Sullivan, both of Springfield, Mass. The general contractor was A. R. Green & Son of Holyoke, Mass.

**TABLE I.**

**Breakdown of construction cost**

| | |
|---|---|
| Cost of building, general contract | $517,918 |
| Plumbing | 30,750 |
| Sprinklers | 21,644 |
| Heating, ventilating, air conditioning | 41,772 |
| Electrical work | 53,622 |
| Power distribution | 20,000 |
| Paving, planting, sidewalks | 10,600 |
| Elevator | 10,487 |
| Total | $706,793 |

Total sq ft=115,000=$6.15 per sq ft



This aerial photo of Snake River was taken for mapping at scale of 100 ft to the inch with first-order plotting instruments. Square outlined in white represents area that would be covered by a photo taken for mapping at same scale but with projector-type plotting instruments. Twenty such photos would be needed to cover area of large photo with proper overlap for stereo mapping.

**CLAUDE W. WAGGONER,** Chief Survey and Drafting Branch, U. S. Army Engineer District, Walla Walla, Wash.

# Photogrammetric mapping of high bluffs

## *First-order plotting instruments yield savings*

Mapping along rivers bordered by barren basalt bluffs up to a thousand feet high is required for three major projects of the Walla Walla District, Corps of Engineers, U. S. Army. For this work the comparatively simple projector type of photogrammetric plotting instrument proved inadequate. The District therefore investigated the advisability of using first-order or high-precision plotting instruments. Although much more expensive in first cost, these yield greater savings in the long run.

The three projects in question involve navigation, power and flood control on the Columbia and Snake Rivers; they are the John Day Project on the Columbia River and the Ice Harbor and Lower Monumental Projects on the Snake River. These projects require the relocation of approximately 500 miles of mainline railroads and primary highways. The major part of these relocations will be along the face or adjacent to the face of the barren basalt bluffs that wall the banks of the Columbia and Snake Rivers, rising to a height of 1,000 ft. Surveying and mapping of these areas by conventional field survey methods would be very costly and time consuming.

Since it would be impossible to accomplish the work within the scheduled time by field survey methods with available personnel, some other method was sought. Photogrammetry offered the only possible solution.

The Walla Walla District had been using modern projector-type photogrammetric plotting instruments for mapping at small scales such as for reservoirs, but had had no experience in large-scale mapping with these instruments. Several years ago, large-scale mapping with earlier projector-type instruments was attempted, but the results did not compare favorably in cost or accuracy with conventional field surveys.

Maps at scales varying from 50 to 100 ft to the inch with contour intervals of from 1 to 5 ft are generally required for the satisfactory design of highways, railroads, levees and dams. Maps of standard accuracy at these scales are required for reliable design cost estimates.

In considering the methods best suited for the work along the Columbia and Snake Rivers, the success of several state highway departments in using projector-type photogrammetric instruments for mapping at the same scales for highway design was noted. However, most of their mapping was done in areas of comparatively low relief, where projector-type photogrammetric plotting instruments yield adequate accuracy at low cost.

Plotters of this type are not designed for the elevations found on the projects of the Walla Walla District. They can cover only about 7 in. of elevation at the scale of the map, which would impose a limit of 700 ft at a mapping scale of 100 ft to the inch, or 350 ft at a mapping scale of 50 ft to the inch. Another deterring factor is that the model becomes fuzzy at the upper and lower limits of the range as the instruments are designed to be in focus at the optimum distance, and the range of clear focus is somewhat limited.

An attempt was made to reset the bar supporting the projectors at two different levels so as to cover the re-

**Taken with Wild photo-theodolite, this photo was used for mapping of bluff area at scale of 50 ft to the inch. Small white areas are photo control points.**

quired differences of elevation. It was found, however, that this could not be accomplished because excessive overlap at the lower elevation did not leave enough space to position the projectors on the supporting bar. If the required 60-percent overlap of the photos is obtained at the upper limit of mapping, there will be an overlap of about 80 percent at the lower limits of the mapping area where there is a 1,000-ft difference in elevation on a single model, when mapping at a scale of 100 ft to the inch. To take two sets of photos at different elevations would not be practical because part of the photo control points would be beyond the range limits of the instrument in either one direction or the other.

The supporting frame or bar on one make of projector-type plotter is long enough to permit the simultaneous setting up of four projectors to make up three stereo models. Another make of plotter has only two projectors, and only one model can be processed at a time, which requires not only shifting of the diapositive from one projector to the other as the models are completed but also a complete setting-up operation for each model. Such a sequence of operations takes time. With both of these instruments the elevations are read by focusing the floating dot on the platen of the tracing table from the image projected from the projectors.

It was found not only that these projector-type instruments were limited in range of elevation but also that it was impossible to control the photos properly for accurate mapping. This was because over half of the photograph was of water since it is necessary to center the photograph riverward from the cliff in order to map the face.

It is mandatory that these photogrammetric surveys at least equal the accuracy attained by good field-survey methods. A minimum of five vertical control points and three horizontal control points are required for each model or stereo pair of photos.

Since it appeared that projector-type instruments could not be effectively used, various first-order or high-precision mapping instruments were studied, such as the Wild Autograph, the Zeiss Stereoplanigraph, and the Nistri Beta No. 2. The analysis indicated that such instruments could produce maps to the same scales and contour intervals with equal or better accuracy using a photograph to a map scale ratio of 1:8 in lieu of a photograph to a map scale ranging from 1:5 to 1:2, as required for projector-type instruments. It was also observed that both sides of the river could be mapped with a single strip of photographs in over 90 percent of the reaches when the photograph was properly located or centered over the river. Thus, the first-order mapping instruments would require from one-sixth to one-twelfth the number of photographs required by the projector-type instruments to accomplish the same result. As the cost of photogrammetric mapping is approximately proportional to the number of photographs required to accomplish the work at a given scale, large savings can be effected by using the first-order instruments in addition to the substantial increase in accuracy.

The basic principle of the first-order instruments is a reversal of the process employed in taking the photographs. In photography the rays of light from the landscape produce pictures in the camera; in the first-order instruments, the light rays pass from the picture to the outside through lenses to form a model of the landscape. The cone of light rays originally entering the camera is reproduced in two projectors in the instrument so as to recover the geometric conditions existing in nature at the time of the original exposure. The light rays from the projectors intersect in space to form a spatial model. This spatial model is viewed stereoscopically through a binocular optical system containing floating marks with which measurements can be made.

The viewing system is such that the operator can view the measuring marks, together with the projected photographic images, without moving his head. Handwheels are used to cause apparent movement of the fused measuring mark in the $X$ and $Y$ directions, and a foot wheel moves the measuring mark in the $Z$ direction. Motions in the $X$ and $Y$ directions are translated through a gearing arrangement to a coordinatograph, where the actual compilation of map detail is accomplished. Elevations are read from a dial connected to the $Z$ motion. The gearing arrangement is such that the scale range at which compilation is accomplished can be varied in ratios of from 0.10 to 9.0 times the spatial model.

For a strip of photographs, the projectors can be made to serve alternately for the left or right photograph, as the need occurs, by changing the position of the prisms in the ocular head so that the photographs as seen in the left and right eyepieces are interchangeable. This procedure is utilized in the extension of control, as well as in mapping without resetting the diapositives.

These first-order instruments are also designed to map from terrestrial photographs such as those of the near vertical or overhanging bluffs that cannot be photographed from the air. By interchanging the $Y$ and $Z$ motions, it is possible to draw contours from such terrestrial photos so that they appear on the map exactly the same as the contours drawn from the vertical photos. Without this interchange the results would appear as distance contours. Since there are many of these very steep bluffs on the Columbia and Snake Rivers, the Walla Walla District has purchased a Wild photo-theodolite in order to map these areas by photogrammetric methods, as they are the most difficult areas to map by conventional field surveys.

### Early first-order surveys

For the reasons that have been discussed, a contract was awarded for the aerial mapping of a reach of about 40 miles on the Snake River at a scale of 100 ft to the inch with 5-ft contours. The cost for this work was approximately 50 percent of the cost of similar surveys by field methods.

These maps were extensively checked for accuracy in order to evaluate them. It was found that the vertical displacement rarely exceeded one foot and where it did, the area consisted of flat blow sand which reflected the sunlight

so that accurate stereo readings could not be obtained.

It is customary on most field surveys, for design purposes, to get rod readings at the base and top of a bluff and sketch in the contours, as it is both expensive and dangerous to rod out such places. These places offer no problems in photogrammetric surveys, and all the irregularities of a contour can be drawn in as precisely as if it were on a gentle slope, if the map scale is large enough to provide adequate space for the contours. For this reason it is believed that photogrammetric surveys of such areas can exceed the accuracy of more costly field surveys.

Since the first contract for this type of survey, the Walla Walla District has awarded three additional mapping contracts, including geological mapping with first-order photogrammetric instruments.

A plan is currently being developed to permit use of first-order photogrammetric surveys for pay-quantity estimates to contractors. All photo control points required for design surveys are being permanently marked so that they can be preserved for this purpose.

The question has been asked, "Will construction contractors accept pay quantities measured by photogrammetric methods?" Actually such methods are being used to a limited extent on some construction jobs now. It is expected that this method will receive wider acceptance as both the engineer and the contractor gain confidence and knowledge of its reliability and economy. It will have practical limitations, of course. One thing is certain—no unfounded claim can be made after the construction is completed that the original surveys were in error. Should any question arise, the original photographs can be set up again in any first-order stereo plotting instrument and resurveyed.

## Field surveys vital

Field surveys account for over 50 percent of the cost of large-scale photogrammetric surveys. They provide the control and are the foundation upon which the mapping is based. If they are inadequate or inaccurate, the final results will not be acceptable.

A most important but less costly part of the job is the photography. Here the quality of the camera and the skill of the airplane pilot and photographer are vital to the success of the operation.

The skill required of the photogrammetrist operating either class of plotting instrument is very important. A man with a good knowledge of topography and surveying can be trained to do contouring with a projector-type instrument in two or three months, but it usually requires two or three years to become fully qualified.

**The ultimate in earthwork quantity measurement is represented by this combination of a Zeiss stereoplanigraph, a Benson Lehner highway plotter, and an Autonetics completely transistorized electronic computer. Plotting and computing are performed simultaneously by one operator.**

Most photogrammetrists operating first-order equipment have had considerable experience and training before being assigned to operate this expensive equipment. A fully qualified projector-type operator can be trained to operate the first-order equipment in one or two months but it takes about a year for him to become proficient. However, the field of photogrammetry is very broad and complicated, and very few men have a full knowledge of the subject.

Since the primary purpose of the large-scale maps is for the design, little or no drafting is done on these maps in the Walla Walla District. They are sufficiently clear as they come from the plotting instruments.

## Computer assistance

Some highway departments take cross sections directly from the aerial photographs onto punch tape or cards using projector-type photogrammetric plotting instruments that ready the data for electronic computers. In our work it has been found that the contour map cannot be eliminated in selecting the best highway or railroad alignment, since a horizontal shift of 1 or 2 ft in the line can increase or decrease the amount of excavation on the face of a rock cliff by many thousand cubic yards. The contours substantially aid in the operation of projecting a new line.

The shortage of trained personnel makes it necessary to use all the electronic equipment possible to compute the data furnished by these surveys. The Walla Walla District has access to an IBM 650 computer that can turn out earthwork computations on short order, but the reading and tabulating of the data from the contour maps onto the punch cards is the bottleneck in the operation. To solve this problem, a manufacturer of special electronic equipment has been contacted and furnished with a description of an instrument desired to measure and record the data directly from the contour map.

This instrument, called a Digi-Scale, is now being made and will be used to perform this operation. With this instrument, the scale is simply set at zero on the center line and the indicator is moved to any point where a cross section reading or break is required. The elevation is punched on the key pack, and both the horizontal distance and the elevation are recorded in any of three forms—punch card, punch tape, or printed.

## Several advantages gained

The use of these methods and the modern first-order equipment described here will result in substantially increased accuracy in earthwork measurements and in quantity computations for surveys in areas of high relief. It is estimated that the total cost of surveys will be reduced by at least 50 percent, and the saving in measuring earthwork quantities will be still greater. Since cross-sectioning on rock bluffs by the conventional methods will be eliminated, accidents to field survey personnel should be substantially reduced. The elimination of this hazard cannot be measured in dollars.

The net gain or saving by using these methods and equipment by the Walla Walla District, Corps of Engineers, should exceed that experienced by eastern state highway departments because of the very rough terrain involved as compared to the more or less flat lands of the East.

*(This article was originally presented as a paper by Mr. Waggoner at the June 1958 Portland Convention of ASCE, before a session of the Surveying and Mapping Division presided over by Carl M. Berry, chairman of the Division's Executive Committee.)*

# Circular columns analyzed by "cracked-section" method

HARRISON KANE, J.M.ASCE, and JOSEPH H. MOORE, A.M.ASCE

Respectively Assistant and Associate Professors, Department of Civil Engineering, The Pennsylvania State University, University Park, Pa.

Analysis and design of reinforced concrete columns subject to combined bending and axial loads has never been a desirable task for the design engineer. This article presents a few curves that are useful in applying Section 1109 (*d*) of the 1956 American Concrete Institute (ACI) code to a circular column in which the reinforcing steel is arranged in a circle. These curves will eliminate at least some of the tedious mathematical work.

In the 1956 ACI code it is required that column design be based on the cracked section theory when the ratio of load eccentricity to column thickness, $e/t$, is greater than 2/3. The following section of the code applies to this condition:

"Section 1109 (*d*): For columns in which the load, $N$, has an eccentricity, $e$, greater than 2/3 the column depth, $t$, the determination of the fiber stress $f_c$ shall be made by use of recognized theory for cracked sections, based on the assumption that the concrete does not resist tension. In such cases the modular ratio for the compressive reinforcement shall be assumed as double the value given in Section 601; however, the stress in the compressive reinforcement when calculated on this basis, shall not be greater than the allowable stress in tension. The maximum combined compressive stress in the concrete shall not exceed 0.45 $f_c'$. For such cases the tensile steel stress shall also be investigated."

The modular ratio referred to in Section 601 is designated as $n$, the ratio of the modulus of elasticity of steel to the modulus of elasticity of concrete, and is given as equal to 30,000 $f_c'$. Thus, it is noted that, by this code, the engineer must determine the location of the crack (generally by trial and error) while evaluating the transformed area of the tensile steel segment using a modular ratio of $n$, and the transformed area of the compressive steel segment using a modular ratio of $2n$.

For members with straight or tapered sides and with bending in one direction, the Wessman method is easy to apply. (See "Reinforced Concrete Columns Under Combined Compression and Bending," by Harold E. Wessman, *Journal* of the American Concrete Institute, September 1946.) The use of $2n$ rather than $n$ to determine the transformed area of the compression steel presents only a minor problem in the Wessman solution.

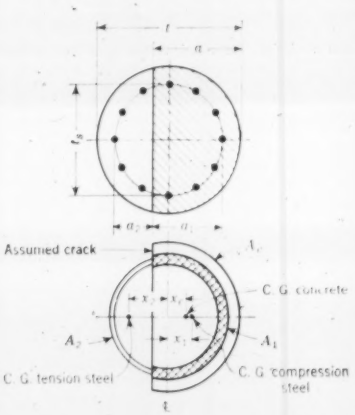



FIG. 1. Illustration of terminology.

When the reinforcement is arranged in a circle, however, the slicing of segments and the determination of the distance to each reinforcing bar, as required by the Wessman method, may not appeal to the designer. For this case, the curves here presented can be used in the analysis of the transformed section of the column with an assumed crack.

The necessary properties for the sector of concrete, the compressive steel segment, and the tensile steel segment may be calculated using coefficients obtained from the curves as follows:

Curves A and B: effective transformed area

Curves C and D: location of the centroid of this area

Curves E and H: moment of inertia of the area about its own centroid

Curves A, C, and E for the effective concrete sector have appeared in many standard textbooks, but curves B, D, and H are innovations of the writers.

## An example given

The use of these curves is best illustrated by an example. The notation is defined in Fig. 1 and Table I. Then suppose that

| | | | |
|---|---|---|---|
| $M$ | = 1,600 in.-kips | $A_s$ | = 12 No. 9 bars |
| $P$ | = 100 kips | | = 12.0 sq in. |
| $t$ | = 20 in. | $n$ | = 10 |
| $t_s$ | = 15 in. | $f_c$ | = 1,350 psi |
| | | $f_s$ | = 20,000 psi |

Therefore $e = 1{,}600 \cdot 100 = 16$ in.

$$\frac{e}{t} = \frac{16}{20} = 0.8 > 2/3$$

If the design follows the 1956 ACI code, Section 1109 (*d*) applies.

Assume the location of the crack to be at $a = 8.5$ in. Therefore

$$k_c = \frac{a}{t} = \frac{8.5}{20} = 0.425$$

$$k_1 = \frac{a_1}{t_e} = \frac{6.0}{15} = 0.400$$

$$k_2 = \frac{a_2}{t_e} = \frac{9.0}{15} = 0.600$$

Obtaining values for the coefficients from the curves of Fig. 2:

TRANSFORMED AREA

| | | |
|---|---|---|
| Concrete | = (0.33) (400) | = 132.0 |
| Compres. steel | = (0.435) (20 − 1) (12.0) | = 99.2 |
| Tension steel | = (0.565) (10) (12.0) | = 67.8 |
| Total transformed area, sq in. | | 299.0 |

| | ARM TO CENTER LINE | | *M* ABOUT CENTER LINE |
|---|---|---|---|
| Concrete | (0.51) (10) | = 5.10 in. | 673.2 |
| Compres. steel | (0.706) (7.5) | = 5.30 in. | 525.8 |
| Tension steel | − (0.55) (7.5) | = − 4.13 in. | − 280.0 |
| Total *M* about center line, cu in. | | | 919.0 |

Therefore, the center of gravity of the cracked section is

919.0 / 299.0 = 3.07 in. from the center line

*I* AT OWN CENTER OF GRAVITY

| | | |
|---|---|---|
| Concrete | (0.06) (20)³ (1/16) = | 600.0 |
| Compres. steel | (0.118) (99.2) (225/8) = | 329.2 |
| Tension steel | (0.28) (67.8) (225/8) = | 533.9 |
| Total, in.⁴ | | 1,463.1 |

If the transformed area is designated as *A*, and the distance to the center of gravity of the cracked section is called *x*, then *I* at the center of gravity of the cracked section is the sum of *I* at its own center of gravity plus $Ax^2$. The quantity $Ax^2$ is calculated as follows:

| | *A* | $x^2$ | |
|---|---|---|---|
| Concrete | 132.0 | × (2.03)² = | 543.9 |
| Compres. steel | 99.2 | × (2.23)² = | 493.3 |
| Tension steel | 67.8 | × (7.20)² = | 3,514.8 |
| Total $Ax^2$ | | | 4,552.0 in.⁴ |

Therefore *I* at the center of gravity of the cracked section is

$$1{,}463.1 + 4{,}552.0 = 6{,}015.1 \text{ in.}^4$$

The unit stress is $-P/A \pm Mc/I$

The maximum concrete fiber stress is

$$-\frac{100{,}000}{299.0} - \frac{100{,}000\ (16 - 3.07)\ (6.93)}{6{,}015.1}$$

$$= -1{,}824 \text{ psi} > 1{,}350 \text{ psi}$$

Also,

$$-\frac{100{,}000}{299.0} + \frac{100{,}000\ (16 - 3.07)\ (13.07)}{6{,}015.1}$$

$$= 2{,}476 \text{ psi}$$

Check on trial crack gives

$$\frac{1{,}824}{1{,}824 + 2{,}476}\ (20) = 8.49 \text{ in.}$$

Therefore the assumption of $a = 8.5$ in. was correct.

The maximum compression steel stress is

$$\left(-\frac{100{,}000}{299.0} - \frac{100{,}000(16 - 3.07)\ (4.43)}{6{,}015.1}\right)20$$

$$= -25{,}720 \text{ psi} > 20{,}000 \text{ psi}$$

The maximum tensile steel stress is

$$\left(-\frac{100{,}000}{299.0} + \frac{100{,}000(16 - 3.07)\ (10.57)}{6{,}015.1}\right)10$$

$$= +19{,}380 \text{ psi} < 20{,}000 \text{ psi}$$

A comparison of the actual stresses with the allowable stresses shows that the column is overloaded.

While for this example the trial value of 8.5 in. is obviously close enough to the resulting value of 8.49 in. to eliminate any second trials, it may be of interest to note that the resulting stress values for some other trial values of *a* which might have been assumed, are as follows:

| Trial value of *a* | 9.5 in. | 8.0 in. |
|---|---|---|
| "Resulting" value of *a* | 8.53 in. | 8.50 in. |
| Maximum concrete fiber stress | − 1,867 psi | − 1,789 psi |
| Maximum compression steel stress | − 26,420 psi | − 25,260 psi |
| Maximum tensile steel stress | + 19,650 psi | + 18,930 psi |

Any of these three solutions yields stress values with a precision acceptable for a problem of this nature. Therefore the experienced designer will find that only one or two trial solutions are needed to obtain reasonable results, and these curves obviously shorten the tedious numerical work in making these trial solutions.

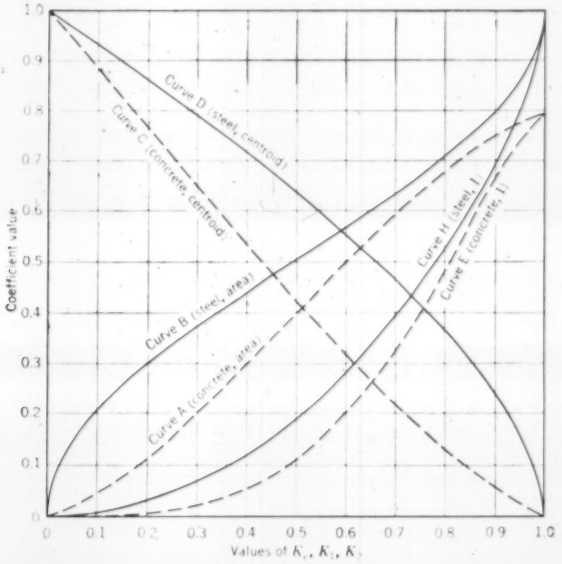



**TABLE I. Terms to be used with curves in column analysis by cracked section**

| ENTER FIG. 2 WITH COEF. | | TRANSFORMED AREA |
|---|---|---|
| Concrete | $k_c = a/t$ | $A_c$ = (Coef. *A*) $t^2$ |
| Compres. steel | $k_1 = a_1/t_e$ | $A_1$ = (Coef. *B*) $(2n - 1)\ A_e$ |
| Tension steel | $k_2 = a_2/t_e$ | $A_2$ = (Coef. *B*) $(n)\ A_e$ |

| DISTANCE FROM CENTER-LINE TO CENTROID | *I* AT OWN CENTER OF GRAVITY |
|---|---|
| $x_c$ = (Coef. *C*) $(t/2)$ | $I_c$ = (Coef. *E*) $(t^4)$ $(1/16)$ |
| $x_1$ = (Coef. *D*) $(t_e/2)$ | $I_1$ = (Coef. *H*) $(A_1)$ $(t_e^2/8)$ |
| $x_2$ = (Coef. *D*) $(t_e/2)$ | $I_2$ = (Coef. *H*) $(A_2)$ $(t_e^2/8)$ |

**FIG. 2. Curves yield coefficients used to determine properties of circular segments and partial steel rings.**

# Ultimate flexural strength of prestressed-concrete composite beams

**KENNETH DIAO, A.M.ASCE,** Structural Engineer, Madigan-Hyland, Consulting Engineers, New York, N. Y.

Various formulas for figuring the ultimate flexural strength of prestressed-concrete composite beams have been suggested by several authors. Among these formulas the ones recommended in the Bureau of Public Roads (BPR) "Criteria for Prestressed Concrete Bridges," 1954, seem to be the simplest to apply, and the values obtained by them for rectangular beams and T-beams with neutral axis in the flanges usually show close agreement with the results of published tests. However, prestressed concrete beams, as commonly employed in highway bridges of composite construction, often have such proportions that under ultimate load the neutral axis falls below the slab, thus rendering the application of the BPR formulas less valid.

A general but still simple procedure for estimating the ultimate moment of prestressed concrete beams for highway bridges of composite construction is presented here. It is believed that this procedure will give results sufficiently accurate for all practical purposes and may serve as a rational refinement to the rather oversimplified formulas of the BPR "Criteria for Prestressed Concrete Bridges." To make the presentation concise, only the notations, working equations, and illustrative examples are given.

## Notation

$A_s$ = total area of prestressing steel, sq in.
$A_{s1}$ = steel area of pretensioning strands, sq in.
$A_{s2}$ = steel area of post-tensioning tendons, sq in.
$f_s'$ = average ultimate tensile stress of prestressing steel, psi
$f_{s1}'$ = ultimate tensile stress of pretensioning strands, psi
$f_{s2}'$ = ultimate tensile stress of post-tensioning tendons, psi
$d$ = depth of section from extreme compressive fiber of composite section to centroid of prestressing steel, inches
$d_1$ = depth of section for pretensioning strands, inches
$d_2$ = depth of section for post-tensioning tendons, inches
$f_{cf}'$ = ultimate cylinder 28-day strength of concrete in the flange (slab), psi
$b$ = effective width of flange of composite section, inches
$t$ = thickness of structural slab, inches
$M_u$ = ultimate moment of composite section, in.-lb
$C_f$ = ultimate compressive force on overhanging portions of flange of composite section, lb
$b'$ = width of top flange of precast beam, inches
$A_{sf}$ = portion of prestressing steel required to develop ultimate compression of overhanging portions of flange, sq in.
$A_{sr}$ = remaining portion of prestressing steel to develop ultimate compression on section above the neutral axis, other than overhanging portions of flange, sq in.
$A_{bs}$ = amount of balanced steel area for beam with overhanging portions of flange disregarded, sq in.

## Working equations

$$A_s = A_{s1} + A_{s2} \quad (1)$$

$$f_s' = (A_{s1} f_{s1}' + A_{s2} f_{s2}')/A_s \quad (2)$$

$$d = (A_{s1} f_{s1}' d_1 + A_{s2} f_{s2}' d_2)/A_s f_s' \quad (3)$$

### Case 1

When

$$A_s \leq 0.85 f_{cf}' b t/f_s'$$

$$M_u = 0.9 A_s f_s' d \quad (4)$$

### Case 2

When

$$A_s > 0.85 f_{cf}' b t/f_s'$$

$$C_f = 0.85 f_{cf}' (b - b')t \quad (5)$$

$$A_{sf} = C_f/f_s' \quad (6)$$

$$A_{sr} = A_s - A_{sf} \quad (7)$$

$$A_{bs} = \frac{0.184 b' d f_{cf}'}{A_s}\left(\frac{A_{s1}}{f_{s1}'} + \frac{A_{s2}}{f_{s2}'}\right) \quad (8)$$

(*a*) If

$$A_{bs} \geq A_{sr}$$

$$M_u = 0.9 A_{sr} f_s' d + C_f (d - t/2) \quad (9)$$

(*b*) If

$$A_{bs} < A_{sr}$$

$$M_u = 0.9 (A_{sr} A_{bs})^{1/2} f_s' d + C_f (d - t/2) \quad (10)$$

## Illustrative examples

**Example 1.** AASHO Standard Section III, $b' = 16$ in.

Beam spacing = 6 ft 9½ in.; $b = 81.5$ in.

Use 7½-in. slab, 1½-in. haunch

$f_{cf}' = 3{,}000$ psi

Use 34 strands of $\frac{7}{16}$-in. diameter at 10.0 in. from the bottom.

$f_s' = 250{,}000$ psi; $d = (45 + 7\frac{1}{2} + 1\frac{1}{2}) - 10 = 44$ in.

$A_s = 34 \times 0.1089 = 3.703$ sq in.

$0.85 f_{cf}' b t f_s' = 6.235$ sq in. $> A_s$.

Case 1 applies.

By Eq. 4, $M_u = 0.9 \times 3.703 \times 250{,}000 \times 44.0 = 36{,}660{,}000$ in.-lb.

**Example 2.** AASHO Standard Section IV, $b' = 20$ in.

Beam spacing = 5 ft 4 in., $b = 64$ in.

Use 7½-in. slab, 1½-in. haunch

$f_{cf}' = 3{,}000$ psi

Use 46 strands of $\frac{7}{16}$-in. diameter at 12.0 in. from the bottom.

Use two Stressteel bars of 1.125-in. diameter at 4.0 in. from the bottom.

$A_{s1} = 46 \times 0.1089 = 5.009$ sq in.

$A_{s2} = 2 \times 0.994 = 1.988$ sq in.

$f_{s1}' = 250{,}000$ psi

$f_{s2}' = 145{,}000$ psi

$d_1 = 51.0$ in.; $d_2 = 59.0$ in.

By Eq. 1: $A_s = 6.997$ sq in.

By Eq. 2: $f_s' = 220{,}100$ psi

By Eq. 3: $d = 52.50$ in.

$0.85 f_{cf}' b t/f_s' = 5.561$ sq in. $< A_s$

Case 2 applies.

By Eq. 5: $C_f = 841{,}500$ lb

By Eq. 6: $A_{sf} = 3.823$ sq in.

By Eq. 7: $A_{sr} = A_s - A_{sf} = 3.174$ sq in.

By Eq. 8: $A_{bs} = 2.796$ sq in. $< A_{sr}$

$(A_{sr} A_{bs})^{1/2} = 2.979$ sq in.

By Eq. 10:

$M_u = 0.9 \times 2.979 \times 220{,}100 \times 52.50 + 841{,}500 \times (52.50 - \frac{1}{2} \times 7.50)$

$= 30{,}980{,}000 + 41{,}020{,}000$

$= 72{,}000{,}000$ in.-lb

# Improving alignment on highway curves

**T. F HICKERSON, M. ASCE,** Formerly Professor of Civil Engineering, University of North Carolina, Chapel Hill, N. C.

To satisfy the requirements of safety with greater speeds on highways and railways, the curvature must be reduced to the minimum allowed by the topography. Too often the degree of curve is rounded off to the nearest whole degree when fractional values would not only improve the alignment but result in an appreciable saving in distance.

In Fig. 1, let the degree of curve $D$, the radius $R$ (ft), and the tangent $T$ (ft) refer to the flatter curve AB, while $d$, $r$, and $t$ are the corresponding parts of the sharper curve ab, the external deflection angle being $\Delta$, (deg).

It follows that

$$T = VA = VB = R \tan \tfrac{1}{2} \Delta$$
$$t = Va = Vb = r \tan \tfrac{1}{2} \Delta$$

Also, $Aa = bB = T - t$.

Assuming unlimited tangents and the same $\Delta$, the distance saved by the use of the flatter curve is:

$$(Aa + \text{curve ab} + bB) - \text{curve AB} =$$
$$[2\ (T - t) + 100\ (\Delta/d)] - 100\ (\Delta/D) \quad \ldots\ldots (1)$$

Noting that

$$R = \frac{5{,}729.58}{D}, \quad r = \frac{5{,}729.58}{d}$$

**FIG. 1. Curve is shortened and flattened by following path AB instead of path AabB.**

substituting in Eq. 1, and reducing, yields:

$$\text{Distance saved} = \left(\frac{1}{D} - \frac{1}{d}\right) \times$$
$$[11{,}459.16\ (\tan \tfrac{1}{2} \Delta) - 100\ \Delta] \quad \ldots\ldots (2)$$

where $D$, $d$, and $\Delta$ are in degrees and the distance saved is in feet.

Thus if $\Delta = 40°20'$, $D = 0°24' = 0.4°$ and $d = 1°$, the distance saved by using the flatter curve is

$$(1/0.4 - 1/1) \times$$
$$[11{,}459.16\ (0.3672680) - 4033.333] =$$
$$262.87 \text{ ft}$$

Further, if $\Delta = 40°20'$, a $1°30'$ curve is 29.21 ft shorter than a $2°$ curve; a $0°30'$ curve is 173.25 ft shorter than a $1°$ curve. Also, if $\Delta = 90°$, a $1°40'$ curve is 245.9 ft shorter than a $2°$ curve.

# Metal drainage pipe shaped to fit

**A 20-ft section of 54-in. Armco drainage pipe (not flattened) is being placed by a Koehring backhoe in a street in Dover, Del.**

Reconstruction of a street in Dover, Del., involved the usual problems encountered in working in a built-up area. In addition, an unusual problem arose. A 54-in. drainage pipe had to be placed, at depths ranging from 10 to 14 ft, between an existing 30-in. reinforced-concrete sanitary sewer and an 8-in. cast-iron water pipe. At several locations the space between these two lines was less than expected and it became necessary to shape the drainage pipe to fit in the available space.

This was done by placing a plank buffer on top of the pipe and dropping the bucket of a backhoe on it. The drainage pipe, of asphalt-coated corrugated metal, showed no signs of breaking, and no damage to its bituminous coating was observed as a result of shaping by this unconventional method.

For traffic control around the construction area, it was necessary to open the trench in short sections, just long enough to accommodate a 20-ft section of pipe, as seen in the accompanying photo.

This information was supplied by R. A. Haber, A.M.ASCE, Chief Engineer, State Highway Department of Delaware.

# THE READERS WRITE

## Aluminum versus steel for long-span roofs

To THE EDITOR: The article by Mr. Lipski on the economics of long-span aluminum roofs (in the October issue, p. 46) intrigued me to the point of making me attempt to check the derivation of Formula 4. I must confess I was unable to follow his reasoning amidst all the subscripts for $W$. I suspect that either his article was not properly translated or that Mr. Lipski slipped a minus alpha. In any event, I certainly would raise doubts as to the validity of the assumption (translated) to the effect that the cost of the aluminum framing would be exactly equal to the cost of steel framing when the total weights, including live loads, are equal.

Furthermore, I am not at all convinced that there exists such a simple relationship between the ratios of $k$ and gamma as suggested in the charts. The economical considerations should properly include properties other than density, allowable stress in tension, and ratio of unit costs. To mention a few: modulus of elasticity, depth to span ratio, and the ratio of strength of connection material to strength of members.

Actually, for most structural applications, it can be shown that aluminum tension members are usually less economical than steel members, unless the structural ratio can be increased considerably by using higher-strength alloys at a lower unit cost than now is possible. Furthermore, aluminum and steel tension members will probably be of equal weight if the capacity is limited by allowable strain.

Notwithstanding the above comments, I admired the unique combination of springs, prestressing steel, steel columns, and aluminum superstructure used to achieve such a pleasing dynamic effect. The growing importance of aluminum as a structural material merits a reevaluation of its economy by the profession when considering the framing of long-span roof structures.

F. ROBERT PREECE, A.M.ASCE
*Civil Engr., Simpson & Stratta, Consulting Engrs.*

*San Francisco, Calif.*

## Preparation of plans for Wolcott Avenue Bridge

To THE EDITOR: It is desirable to clarify some items in the article on the Wolcott Avenue Bridge in Hartford, Conn., by Gordon C. Linberg and M. Schupack, A.M. ASCE, which appeared in the March 1958 issue (p. 37).

The original design—for a precast, prestressed structure—was completed by Thomas Worcester before bids were taken for selection of the contractor. The contractor presented, in sketches, an alternate design for a cast-in-place bridge superstructure. Modifications of the suggested alternate were requested by the Greater Hartford Bridge Authority.

Changes proposed by the Thomas Worcester Co. resulted in a mutually acceptable design based on the contractor's concept of cast-in-place, monolithically poured girders and deck section. The new plans were prepared complete by the Thomas Worcester Co. under the direction of the writer.

JOHN MAKARETZ
*Badger Manufacturing Co. (Formerly Chief Structural Engr., Thomas Worcester Co.)*
*Cambridge, Mass.*

## The mystery of the missing mural

To THE EDITOR: I read with interest the explanation given in your July 1958 issue (p. 74) of the disappearance of the magnificent mural—with its definition of engineering—from the wall of the Engineering Societies' Library in the Engineering Societies Building in New York, N. Y.

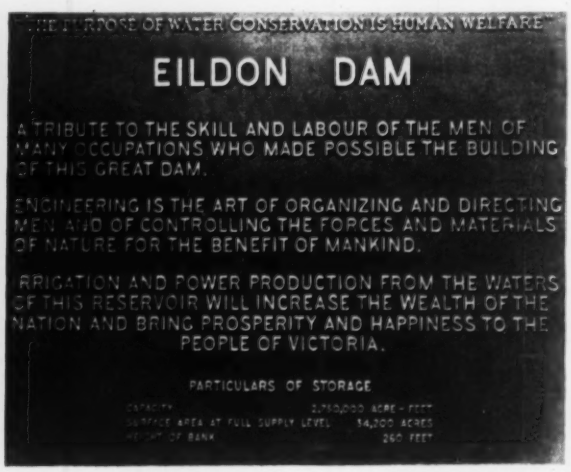
The legend, that is, the definition of engineering, has not been forgotten. It was because of its disappearance from the Engineering Societies' Library that I arranged for it to be preserved in bronze on a large commemorative tablet erected on the occasion of the completion of the Eildon Dam, at that time (1956) the largest dam in Australia.

I might add that American association with this great structure was not confined to the commemorative tablet. J. L. Savage, Hon M.ASCE, was consulted in regard to certain aspects of our designs for the dam, and its construction brought, for the first time, a large American contracting firm, Utah Construction Company, to Australia. I enclose photographs of the tablet and dam.

L. R. EAST, M.ASCE
*Chairman, State Rivers and Water Supply Commission of Victoria*

*Victoria, Australia*

**Eildon Dam, designed and built by State Rivers and Water Supply Commission of Victoria, Australia, impounds 2,750,000 acre-ft. Dam is 260 ft high and contains 13 million cu yd of earth and rock fill. Photo at right shows bronze commemorative tablet erected when dam was completed in 1956.**


THE PURPOSE OF WATER CONSERVATION IS HUMAN WELFARE
EILDON DAM
A TRIBUTE TO THE SKILL AND LABOUR OF THE MEN OF MANY OCCUPATIONS WHO MADE POSSIBLE THE BUILDING OF THIS GREAT DAM.
ENGINEERING IS THE ART OF ORGANIZING AND DIRECTING MEN AND OF CONTROLLING THE FORCES AND MATERIALS OF NATURE FOR THE BENEFIT OF MANKIND.
IRRIGATION AND POWER PRODUCTION FROM THE WATERS OF THIS RESERVOIR WILL INCREASE THE WEALTH OF THE NATION AND BRING PROSPERITY AND HAPPINESS TO THE PEOPLE OF VICTORIA.
PARTICULARS OF STORAGE
CAPACITY 2,750,000 ACRE-FEET
SURFACE AREA AT FULL SUPPLY LEVEL 14,200 ACRES
HEIGHT OF BANK 260 FEET

# SOCIETY NEWS

*MERRY CHRISTMAS* *HAPPY NEW YEAR*

## Walter Jessup Retires as Editor of "Civil Engineering"

If to retire means "to withdraw oneself from business, public life, or active service," as the dictionary defines it, then it cannot accurately be said that Walter Jessup is retiring. Rather Mr. Jessup is retiring as editor of CIVIL ENGINEERING, the mazazine to which he came as first editor in September 1930. In the intervening twenty-eight years he has served ASCE and CIVIL ENGINEERING continuously with the exception of three years on leave for wartime service as an officer in the Corps of Engineers.

Mr. Jessup was editor of CIVIL ENGINEERING from 1930 to 1935, when he was transferred to the position of Field Secretary of ASCE. Later he was Washington Representative and Acting Assistant Secretary of the Society. Beginning in July 1942, he served in the Army Corps of Engineers—first as a training officer in the Engineer Replacement Center at Fort Belvoir and later in the Office of the Chief of Engineers in Washington. He attained the rank of Lieutenant Colonel. Upon leaving the Army in the fall of 1945, Mr. Jessup returned to the Society in charge of its Western headquarters in Los Angeles. Since 1948 he has been editor of CIVIL ENGINEERING.

In his long service with the Society as editor, Mr. Jessup has seen CIVIL ENGINEERING tripled in size and usefulness from the first issue that appeared in 1930. To a considerable extent he has been responsible for its growth and development. He has been responsible for changes in typography and format and in editorial approach that have resulted in a modernized and greatly improved publication.

Despite his dedicated approach to the job of editor, Mr. Jessup has found time for larger service to the Society and the profession. For several years he has represented ASCE on the board of the Engineering Societies Library—one of two staff members ever to serve in such a capacity. He is a trustee of the Engineering Index, and a member of the Information Committee for the Engineers Council for Professional Development. Mr. Jessup has aided the campaign for the new United Engineering Center in multiple ways, serving as chairman of a committee of editors for fund raising and as public relations representative for the Member Gifts Campaign. On the national scene, he has served the Atomic Energy Commission for seven years as a member of its Advisory Committee on Industrial Information, made up of science and technical editors.

WALTER E. JESSUP

A native of California, Mr. Jessup graduated from the University of Southern California in 1910 with a bachelor of arts degree, and from the University of Wisconsin in 1912 with the degree of civil engineer. In his early career he worked as a field engineer on construction projects in the West. After overseas service in the Corps of Engineers in World War I, he established a consulting practice with Henry Z. Osborne, M.ASCE, as a partner.

Mr. Jessup is returning now to California, where he will reside in San Marino and resume the practice of civil engineering which was interrupted when he joined the Society staff. All who know Mr. Jessup know that he will regard "retirement" as an opportunity for enlarged service to the Society and the profession. For avocations he has a keen and long-standing interest in stamp collecting and gardening. He is also an expert in woodworking and in the restoration of antiques.

In his retirement Mr. Jessup will take with him the good wishes of the host of friends he has made among the members and CIVIL ENGINEERING authors. He will also have the good wishes of the ASCE Headquarters staff, to whom he has been at all times an understanding and inspiring leader.

# YOUR UNITED ENGINEERING CENTER

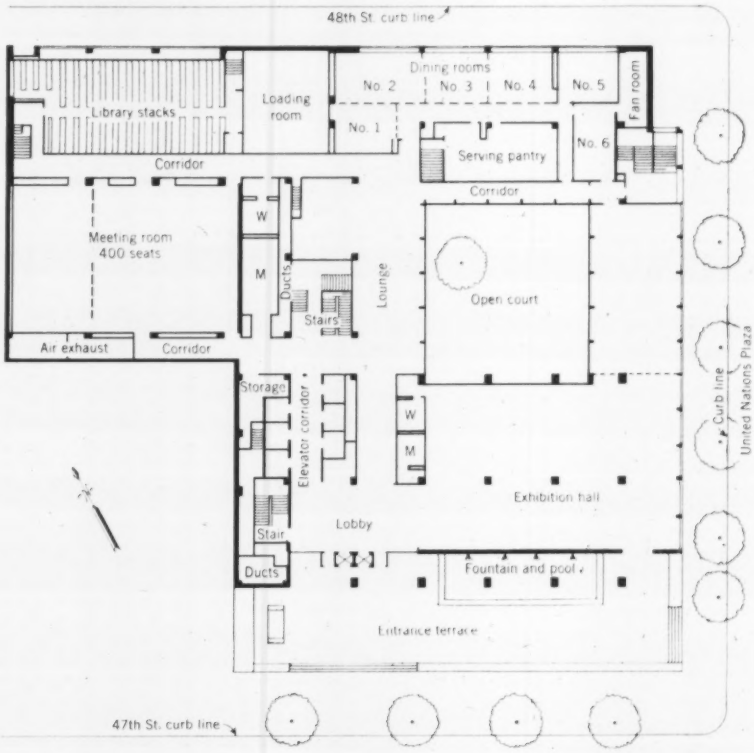
**New United Engineering Center is shown in architects' rendering. First, second, and basement floors will cover the whole plot. The twenty-story tower—to house offices of the engineering societies—will occupy only one-quarter of the ground area. As the need develops, set-back floors can be added to the lower level.**

Architects for the United Engineering Center, Shreve, Lamb, and Harmon Associates, have developed the typical floor plans shown here. With entrance on 47th Street at United Nations Plaza the lobby, exhibit hall, meeting room, and dining facilities are on the first floor. On the second floor are the library and reading room. A cafeteria and centralized services will occupy the basement floor. These floors will cover the whole plot, while the tower, rising 20 stories above 47th St., will occupy only one quarter of the ground area. Offices of the engineering societies will be in the tower.

As need for more space in the building develops in the future, the architects visualize adding set-back floors to the lower level. The United Engineering Trustees propose that the future expansions will be financed from reserves accumulated before the expansion is needed.

It is welcome news that the American Institute of Industrial Engineers, Inc., and the Society of Women Engineers have accepted quotas and joined the campaign for fund raising. The AIIE is made up of 84 chapters within six regions of the country. It has 25 committeemen at work on the Member Gifts Campaign. The Institute has accepted a quota of $70,000, and an excellent start has been made toward meeting this obligation. The ac-

**Plan of first floor for new United Engineering Center includes meeting room, dining, and exhibition facilities. Entrance is on terrace.**

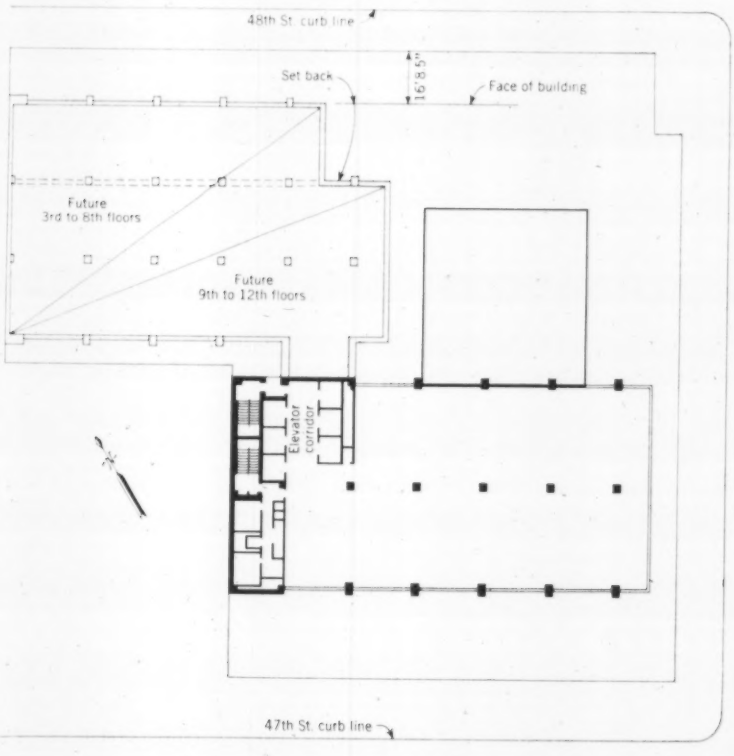


# ASCE Giving for UEC Passes $169,000 as of November 10

| Local Section | Quota | Amount Pledged | % Quota |
|---|---|---|---|
| ZONE I | $197,300 | $ 64,946 | 33 |
| **District 1** | **133,300** | **52,986** | **40** |
| Brazil | 2,100 | | |
| Metropolitan | 119,200 | 52,986 | 45 |
| Panama | 1,300 | | |
| Puerto Rico | 3,100 | | |
| Rep. Colombia | 2,400 | | |
| Venezuelan | 5,200 | | |
| **District 2** | **43,400** | **4,090** | **9** |
| Connecticut | 11,000 | 250 | 2 |
| Maine | 4,700 | 150 | 3 |
| Massachusetts | 23,000 | 2,977 | 13 |
| New Hampshire | 1,800 | 173 | 10 |
| Rhode Island | 2,900 | 540 | 19 |
| **District 3** | **20,600** | **7,870** | **38** |
| Buffalo | 4,400 | 1,655 | 38 |
| Ithaca | 2,400 | 315 | 13 |
| Mohawk-Hudson | 7,500 | 2,360 | 32 |
| Rochester | 1,900 | 1,189 | 63 |
| Syracuse | 4,400 | 2,351 | 54 |
| ZONE II | 169,700 | 40,244 | 24 |
| **District 4** | **34,000** | **20,758** | **61** |
| Delaware | 4,100 | 1,530 | 37 |
| Lehigh Valley | 4,200 | 3,405 | 82 |
| Philadelphia | 20,000 | 13,516 | 67 |
| Central Pa. | 5,700 | 2,307 | 42 |
| **District 5** | **27,000** | **1,697** | **6** |
| Nat'l Capital | 27,000 | 1,697 | 6 |
| **District 6** | **49,000** | **9,232** | **19** |
| Maryland | 15,000 | 3,406 | 23 |
| Pittsburgh | 17,000 | 3,250 | 19 |
| Virginia | 13,300 | 2,540 | 19 |
| West Virginia | 3,700 | 36 | 1 |
| **District 10** | **59,700** | **8,557** | **16** |
| Alabama | 8,900 | 1,020 | 11 |
| Florida | 11,500 | 320 | 3 |
| Georgia | 11,000 | 3,566 | 33 |
| Miami | 5,200 | 75 | 1 |
| Nashville | 2,700 | 683 | 25 |
| N. Carolina | 6,300 | 1,368 | 22 |
| S. Carolina | 4,900 | 525 | 11 |
| Tenn. Valley | 9,200 | 1,000 | 11 |
| ZONE III | 202,200 | 30,329 | 15 |
| **District 7** | **39,900** | **945** | **3** |
| Duluth | 1,500 | | |
| Michigan | 18,000 | 305 | 2 |
| Northwestern | 8,000 | 5 | 1 |
| Wisconsin | 10,700 | 635 | 6 |
| So. Dakota | 1,700 | | |
| **District 8** | **37,100** | **5,655** | **15** |
| Cent. Ill. | 6,500 | 1,700 | 26 |
| Illinois | 29,000 | 3,955 | 14 |
| Tri-City | 1,600 | | |
| **District 9** | **45,700** | **12,282** | **27** |
| Akron | 3,100 | | |
| Central Ohio | 5,100 | 60 | 1 |
| Cincinnati | 4,700 | 3,065 | 65 |
| Cleveland | 9,300 | 745 | 8 |
| Dayton | 3,300 | 85 | 3 |
| Indiana | 11,000 | 3,131 | 27 |
| Kentucky | 6,100 | 5,196 | 85 |
| Toledo | 3,100 | | |
| **District 14** | **31,500** | **7,600** | **24** |
| Mid-Missouri | 3,500 | 350 | 10 |
| Mid-South | 11,000 | 3,005 | 27 |
| Oklahoma | 6,900 | 15 | 1 |
| St. Louis | 10,100 | 4,230 | 42 |
| **District 16** | **48,000** | **3,847** | **8** |
| Colorado | 13,900 | 1,618 | 12 |
| Iowa | 5,900 | 240 | 4 |
| Kansas City | 12,000 | 1,000 | 8 |
| Kansas | 7,600 | 959 | 13 |
| Nebraska | 6,300 | 30 | 1 |
| Wyoming | 2,300 | | |
| ZONE IV | 230,800 | 33,772 | 14 |
| **District 11** | **132,600** | **24,500** | **18** |
| Arizona | 5,000 | 1,120 | 23 |
| Hawaii | 6,300 | | |
| Intermountain | 4,700 | 5 | 1 |
| Los Angeles | 50,200 | 4,975 | 10 |
| Sacramento | 16,300 | 100 | 1 |
| San Diego | 6,000 | 400 | 7 |
| San Francisco | 44,100 | 17,900 | 41 |
| **District 12** | **40,400** | **3,503** | **9** |
| Alaska | 2,200 | | |
| Columbia | 2,200 | 300 | 14 |
| Montana | 3,300 | | |
| Oregon | 10,900 | 435 | 4 |
| Seattle | 12,200 | 880 | 7 |
| S. Idaho | 2,300 | | |
| Spokane | 3,100 | 318 | 10 |
| Tacoma | 4,200 | 1,570 | 37 |
| **District 15** | **57,800** | **5,769** | **10** |
| Louisiana | 13,000 | 1,005 | 8 |
| Mexico | 1,400 | | |
| New Mexico | 4,000 | | |
| Texas | 39,400 | 4,764 | 12 |
| | *$800,000 | $169,291 | 21 |

*The $800,000 Society quota is apportioned according to Local Section membership.

**Typical floor plan for tower of United Engineering Center is shown here. Future expansions are indicated. Society offices will be in tower.**




ceptance of a $7,000 quota by the members of the SWE brings added enthusiasm to the campaign as well as subscriptions.

### First Million Pledged

Member giving is accelerating. Gifts have passed the million-dollar mark—one third of the way to the goal—and almost half of it is in cash. The first million has come from just over 8 percent of the 190,000 members of the societies that will occupy the Center. Table I and the bar graph in Fig. 1 show the status as of November 7.

AIEE gifts lead with one-third of a million dollars from 7,390 members. AIEE, Schenectady, Richland, and Spokane sections have reached and exceeded their quotas. ASME Dayton also has passed the 100 percent mark. The American Institute of Consulting Engineers (AICE) is out in front with gifts of $500 each from 34 of its members.

In Table II, ASCE member giving by Zones, Districts and Local Sections is shown. It is to be noted that our Kentucky and Lehigh Valley Sections are in sight of their quota goal; that District 4 is two-thirds of the way toward its goal; that Zone I is ahead with 33 percent; and that the Society as a whole has raised nearly one-quarter of its accepted obligation of $800,000.

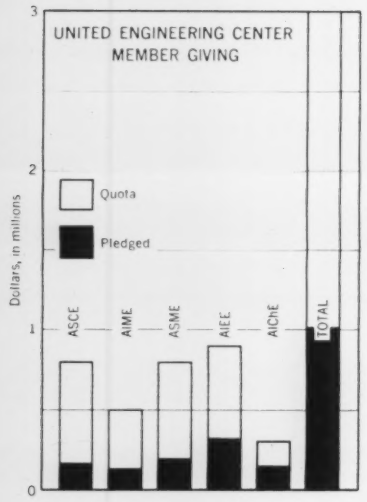



**Table I. Quotas and Pledges to UEC as of November 7**

| Society | Goal in Dollars | No. of Subscribers | Amount Pledged | % of Goal | $ per Subscriber |
|---|---|---|---|---|---|
| ASCE | 800,000 | 1,792 | 170,440 | 21 | 95 |
| AIME | 500,000 | 1,063 | 135,610 | 27 | 127 |
| ASME | 800,000 | 3,133 | 202,370 | 25 | 65 |
| AIEE | 900,000 | 7,399 | 325,440 | 36 | 44 |
| AIChE | 300,000 | 2,375 | 154,800 | 52 | 65 |
| AICE | 80,000 | 34 | 17,030 | 21 | 500 |
| AIHE | 70,000 | 10 | 4,200 | 6 | 420 |
| SWE | 7,000 | 1 | 1,000 | 14 | 1000 |
| Others | .... | 72 | 1,960 | .. | 27 |
| Total | *3,000,000 | 15,870 | 1,012,850 | 34 | 64 |
| Industry | 5,000,000 | 232 | 3,748,580 | 75 | 16,100 |
| Grand Total | 8,000,000 | 16,102 | 4,761,430 | 60 | |

*While the overall goal of member giving is shown as $3,000,000, the quotas accepted by the Societies total $3,457,000

**Fig. 1. United Engineering Center Member Giving as of November 7.**

**Flash: Kentucky and Lehigh Valley Sections have met their quotas. The Philadelphia Section is close behind.**

## Study Tours Conclude Congress on Large Dams

Following the Sixth International Congress on Large Dams, which was attended by more than 750 from 45 countries, nearly 300 registrants decided to profit by the post-congress study tours which went into three areas of the United States.

The **Southeastern Study Tour** covered most of the TVA area, the ALCOA and Alabama Power Company dams, and the Vicksburg Waterways Experiment Station of the Corps of Engineers. The Tennessee Valley Section of ASCE was host to the Southeastern Study Tour group. About 70 tour participants and 70 Section members and their wives enjoyed a social hour, following a dinner in the main ballroom of the Andrew Johnson Hotel in Knoxville. Section president Nathan E. Way presided over an interesting and entertaining program which was highlighted by a short message from Gen. Herbert D. Vogel, chairman of the Board of Directors for the Tennessee Valley Authority.

The **Midwestern Study Tour** included the great dams on the Missouri built by the Corps of Engineers and the dams of the Colorado-Big Thompson Project built by the Bureau of Reclamation. A visit was also made to Montgomery Dam, where Black and Veatch and the City of Colorado Springs were hosts for a refreshments stop at the scenic town of Fairplay, Col. The Nebraska Section of ASCE was host for a dinner at the Blackstone Hotel in Omaha. Rebelo-Pinto, newly elected president of the International Commission on Large Dams, was among those making this tour. He praised, particularly, the "comprehensive plan" to utilize all the water resources of a river basin—"unique as to its large scale." "The watershed of the Missouri is 15 times the area of Portugal," Mr. Rebelo-Pinto said.

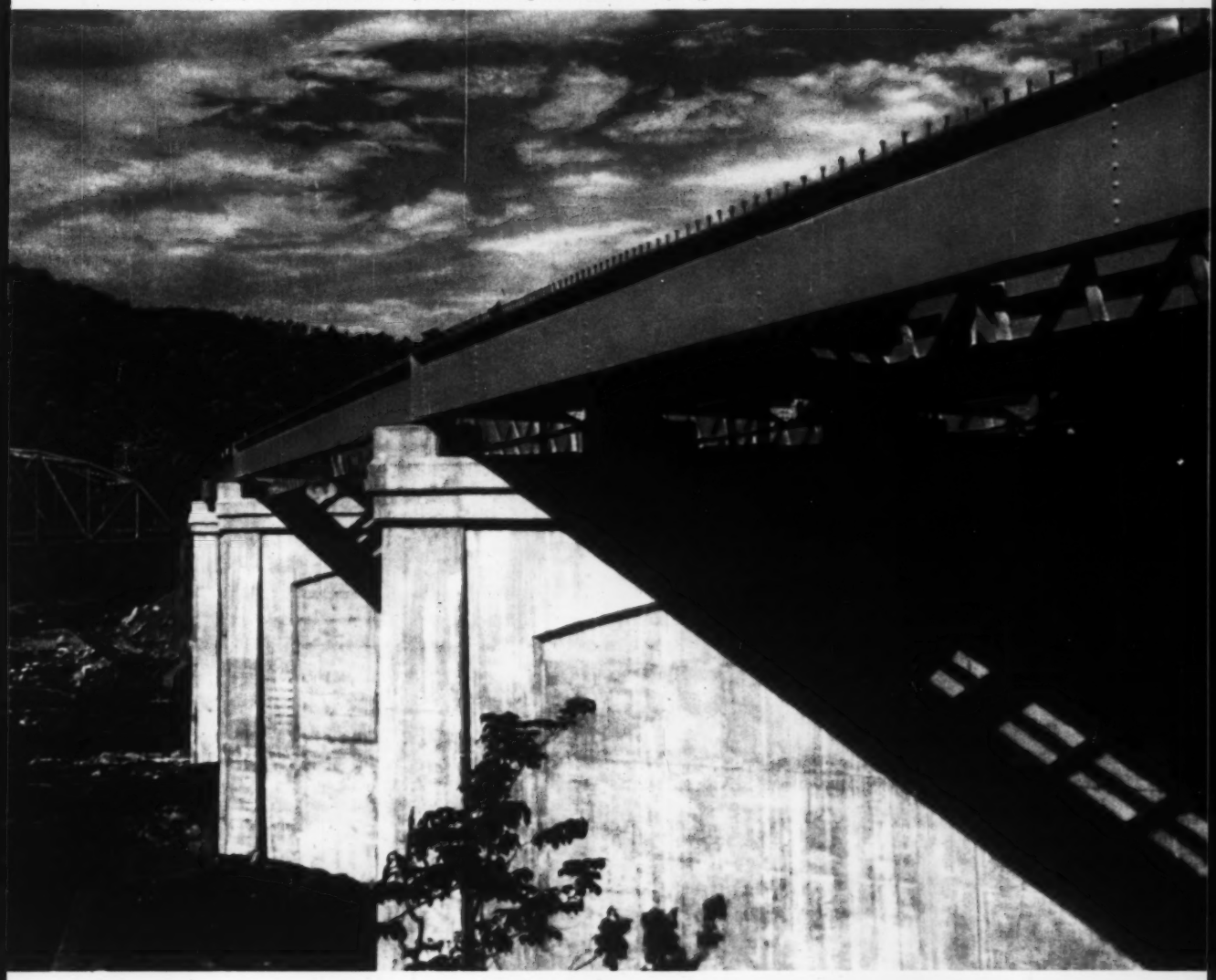
The **Northwestern Study Tour,** most popular of the three, had nearly 150 participants. The tour included visits to the great dams on the Columbia River and the dams of the Pacific Power and Light Company near Portland. Visits were also made to dams near Eugene, Ore., and those of the Portland General Electric Company. The Oregon Section of ASCE, of which Charles F. Craig is president, sponsored a reception in the Benson Hotel, for which there was a large turn-out of local members of ASCE and prominent citizens who extended warm hospitality to the foreign visitors. The touring party departed from the Northwest with a feeling of admiration for the beauty of the area, its accomplishments, and the hospitality of the people.

ASCE President Francis S. Friel, chairman of the United States Committee on Large Dams, flew to the Northwest and Denver in order to take part in those tours and to extend greetings to the foreign guests on behalf of the engineers of this country. Gerald T. McCarthy, M. ASCE, vice chairman of USCOLD, participated in the Southeastern Tour.

It is reported that President Friel, assisted by able and enthusiastic committees, was the principal driving force behind the success of the Sixth Congress on Large Dams.

**Tennessee Valley Section of ASCE was dinner host to participants in the Sixth International Commission on Large Dams who took the Southeastern Study Tour. Shown at the speaker's table are, in usual order, George K. Leonard, chief engineer of the TVA and deputy chairman of the Southeastern Tour Committee; Mrs. Leonard; Thorild Persson and Mrs. Persson, from Sweden; Mrs. Vogel; Gen. Herbert D. Vogel, chairman of the Board of the TVA; Nathan E. Way, president of Tennessee Valley Section; Mrs. Way; Susumu Nagata and Jiro Nishimura, Japan; Mrs. Blee and Clarence E. Blee, chairman of the Southeastern Study Tour Committee.**

**STEEL DOES THE JOB.** Many tons of Bethlehem structural steel and reinforcing bars were used in this new dual bridge on Route 60, over the Jackson River near Covington. Fabricator: Roanoke Iron & Bridge Works, Inc.; General Contractor: McDowall & Wood, Inc.; Erector: E. F. Blankenship Co.; Reinforcing steel fabricated by Virginia Steel Co., Inc., and Montague Betts Co., Inc.



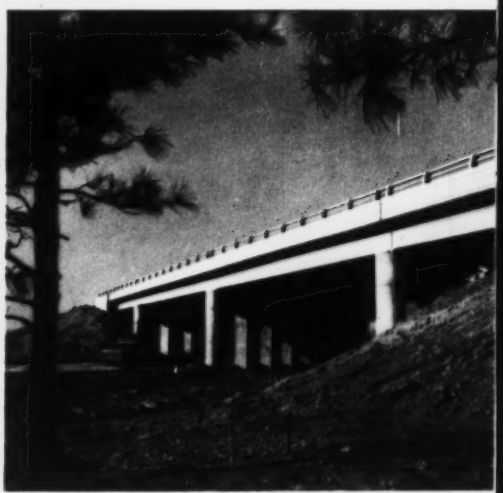
## HIGHWAY PROGRESS IN THE

# OLD DOMINION

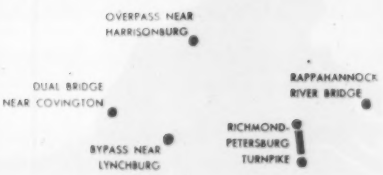
BETHLEHEM STEEL

Steelwork for South Crossing of Turnpike's Appamattox River between Colonial Heights and Petersburg. This bridge is the largest of the Bethlehem-built structures on this new 4-lane traffic artery. Contractor for substructure and deck: Blythe Brothers Co.

Turnpike Authority chose structural steel for bridges because of its economy and durability. These Bethlehem Structural Shapes are in Wythe St. Bridge, Petersburg.



Lombardy St. Crossing, near northern end of Turnpike. This is one of 40 Turnpike structures erected in Richmond.




# STEEL in many forms for Virginia's Highways

In Virginia they're not just talking about the need for better highways. They're doing something about it. A vigorous statewide highway improvement program has been under way ever since the end of World War II. During this 13-year period the Virginia Department of Highways has had the immense responsibility of allocating approximately $1,056,740,000 in highway funds.

Bethlehem has played a major part in this huge task of highway improvement—in fabricating and erecting the steelwork for bridges large and small, and in supplying a wide variety of highway steels. Some of this activity throughout the state is shown in the accompanying pictures. On page 4 is a long list of steel supplied by Bethlehem to the construction industry.

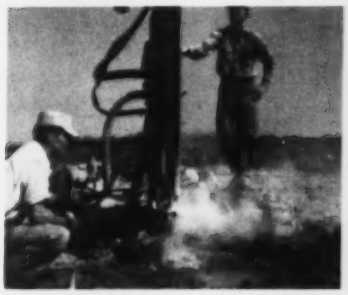
## 77 Bridges... and they're all steel

The Richmond-Petersburg Turnpike, a new high-speed toll road opened to traffic in mid-1958, contains 77 bridges in its 34.7-mile length. A large number of these were fabricated by Bethlehem for the Richmond-Petersburg Turnpike Authority. Four of the steel structures are shown at left, and immediately below.

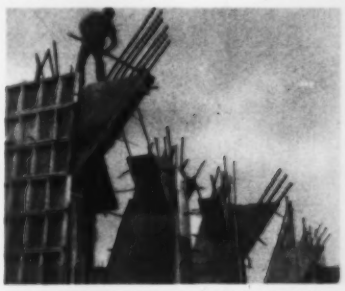
**BETHLEHEM STEEL**

Bethlehem-built bridge carries the 4-lane Turnpike over right-of-way of Atlantic Coast Line Railroad, in Dinwiddie County.

**NO DRAINAGE PROBLEMS WITH STEEL PIPE.** This 48-in. culvert pipe, fabricated from Bethlehem galvanized sheets, is being installed by Wright Contracting Co., near Harrisonburg.



**DRILL STEEL BITES DEEP INTO SANDSTONE.** Crawler-type drilling rigs, fitted with Bethlehem Hollow Drill Steel, bore blast holes at site of overpass at intersection of Routes 11 and 33.



**STEEL SINEWS FOR OVERPASS.** Bethlehem Reinforcing Bars protrude from concrete columns during construction of bridge on Route 33. Contractor: Wright Contracting Co.

**H-PILES TO SHOULDER THE LOAD.** These Bethlehem H-Piles have been driven to bedrock for the foundations of a new bridge on Route 29 Bypass, which will skirt Lynchburg.

**MOTORISTS FOLLOW THE BEAM.** Bethlehem Beam Guard Rail, mounted on sturdy steel posts, installed along curve near Petersburg. Contractor: Blythe Brothers Co.

**RAPPAHANNOCK RIVER BRIDGE.** Bethlehem fabricated and erected 12,690 tons of steel for the superstructure of this cantilevered structure which spans the historic Rappahannock at White Stone, on Route 200, approximately 8 miles from Chesapeake Bay. It is the largest bridge ever built for the Virginia Department of Highways. Designers: Modjeski & Masters.

# *A Complete Line of Construction Steel*

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Barbed wire
Bldst furnace slag and commercial stone
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Bridge rail
Cables for suspension bridges
Center strip and keyway
Centering, solid steel over joists
Culvert sheets, galvanized
Curb facing
Digging bars
Drill steel, hollow and solid
Dowels, hook-bolt
Dowel units
Fabricated steel bridges and buildings
Fasteners of all types
Fence and posts
Form stakes
Form wire
Guard rail—beam and cable
Hardware, timber bridge
High-strength bolts
Joists, open-web, shortspan and longspan
Nails
Paving steels
Piling, steel sheet and H-piles
Pipe, large-diameter welded
Pipe piles
Pipe
Plate
Posts, steel fence
Posts, steel guard rail
Reinforcing bar accessories
Reinforcing bars, plain and fabricated
Rock bolts
Roofing and siding, steel
Structural steel shapes
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# Preview of Los Angeles Convention Program

Once again Los Angeles and the Los Angeles Section will be hosts to an ASCE Convention. The dates are February 8-13, and the place the Statler Hotel. Both the technical and social programs promise to be of exceptional interest, and the full program will be printed in the January issue. In the meantime, here is a preview of some of the highlights.

## The Technical Division Program

The Construction Division program will feature sessions on the building of Glen Canyon Dam, the construction of ballistic missile facilities, and prestressed concrete construction in Russia. The Hyperion Outfall Sewer will be discussed in a joint session with the Sanitary Engineering Division. The joint program will be followed by a field trip to the pipe-casting yard and the Hyperion Plant site.

The Hydraulics Division has planned a full technical session, with papers on research, tidal hydraulics, hydrology, hydraulic structures, and sedimentation. Also on its agenda are a joint field trip to the Long Beach-Los Angeles Harbor area with the Waterways and Harbors Division and an all-day trip to projects in the Los Angeles County Drainage area. The latter trip will include visits to the debris basins, channels, and the extensive water-conservation spreading grounds on the Rio Hondo channel downstream from Whittier Narrows Dam.

Slated for discussion on the Highway Division program are urban transportation, future planning, and traffic engineering—a joint program with the City Planning Division. There will also be an all-day field trip to see the extensive freeway system in Los Angeles. The visitor to Los Angeles, engineer or otherwise, who has not been in Los Angeles for several years, cannot fail to be impressed by the seemingly complex, but nevertheless facile, freeway system that handles Los Angeles County's more than 2,500,000 motor vehicles. These multilane thoroughfares, sometimes with two-deck overpasses at the interchanges, have enabled Los Angeles to keep expanding, while permitting California's traditional gracious living farther and farther away from business.

In addition to its meeting with the Highway Division, the City Planning Division will meet jointly with the Air Transport Division and the Waterways and Harbors Division. Its program will be highlighted on Thursday (Planning Day) by a session on urban renewal, and the Thirty-Fifth Anniversary Dinner with the Southern California Planning Congress.

The Structural Division is planning sessions on plasticity in structural design, in concrete, and in steel. It will also have a joint session with the Soil Mechanics and Foundations Division on earthquakes. In addition to its participation in this joint program, the Soil Mechanics and Foundations Division will also discuss "Ground Shock Due to Atomic Blast" and "Theoretical Approach to Soil Dynamics."

The Irrigation and Drainage Division program will have sessions on water conservation, research, and betterment and the evaluation of irrigation systems. This Division will also join the Hydraulics Division in sponsoring a flood-control field trip.

Finally, the Power Division has scheduled sessions on nuclear energy and on the control of cracking in masonry dams.

## Lots to See in Los Angeles

With all its growth and expansion, Los Angeles still has the many points of historical and scenic interest that will make it attractive to the engineer visitor bent on combining Convention attendance with some sightseeing and, possibly, vacationing.

Unchanged through the years is Olvera Street, a bit of Old Mexico that takes the visitor back to the early Spanish days of Los Angeles. With attractive restaurants, tea rooms, and curio shops, this area adjoins the Plaza, around which the City of Los Angeles was built. The Church of Our Lady, facing the Plaza on the west, houses many religious paintings that represent the artistic talents of the early padres. Although there are plenty of Chinatowns all along the West Coast, none is quainter or more attractive than Chinatown in Los An-

**San Fernando Mission, two miles west of the City of San Fernando, is one of many historic attractions in the Los Angeles area that will be readily accessible to Convention visitors this February.**

**Disneyland, which has been called the greatest engineer trap ever built by a mouse, faithfully reproduces old Los Angeles. Disneyland will be visited by the engineers and their ladies on Wednesday, February 11.**

**Los Angeles City Hall typifies the modern busy metropolis. This model of utilitarian architecture houses the city's executive and municipal court offices. It was completed in 1928 at a cost of $9,726,837.**

geles. There, along "Gin Ling Way," or the Street of the Golden Palace, are lily pools and courts and shops which offer silks, antiques, jewelry, and other souvenirs. China City, near Olvera Street, has typical Chinese temples and theaters, as well as shops, bazaars, and restaurants.

Exposition Park, with its sunken rose gardens; Griffith Park and Griffith Park Planetarium, which houses the "Theater of the Universe;" and the Hollywood Bowl, a natural amphitheater seating 20,000, are among the other attractions.

Outside the city proper, there are two famous missions, located at San Gabriel and San Fernando. The San Gabriel Mission, founded in 1771 and still in use, possesses one of the finest collections of mission relics in existence, including striking examples of early Indian art as well as ancient wooden statues from Spain.

Farther away is the Mt. Wilson Observatory which, at an elevation of 6,000 ft, gives a view at night of sixty surrounding communities. Offshore 25 miles is Catalina Island, famous for its submarine gardens and fishing. Needless to say, beaches abound all along the shore of the Pacific from Malibu on the north to Laguna on the south.

### Smoker and puffer planned

So that the ladies won't feel left out of things, the entertainment committee for the Convention is planning some special events for the wives on a modified "togetherness" theme.

On Tuesday, February 10, the night of the Men's Smoker, the ladies will have a "puffer"—with dinner and fashion show, both at the Hotel Statler-Hilton. The plan is for the ladies and gentlemen to get together later in the same evening. On Wednesday, there will be a visit to Disneyland for both the engineers and their wives, followed by a dinner with Disneyland entertainment.

Other features on the ladies program include television station visits and an Oriental tea, with Oriental entertainment.

Mr. and Mrs. Irvan F. Mendenhall are chairmen of the entertainment and ladies' programs for the Convention. Trent Dames is general Convention chairman.

## Society Acquires Two New Films

Two interesting and instructive new sound and color films have been made available to the Society through the generosity of the Portland Cement Association. One is entitled "Building a Highway," the other "Water Control." Both may be borrowed by the Local Sections, Student Chapters, P.T.A. groups, or similar educational organizations.

"Building a Highway" affords a 16-minute sightseeing trip behind the scenes of "one of the most complex, yet least known of modern businesses." It gives actual views of men and machines at work on the 41,000-mile National Highway System, plus work on other roads and streets. Every construction step is explained in simple language. The film also takes in aerial photographic surveys and shows electronic computers solving in a few hours design problems that would normally require weeks of work.

"Water Control," which runs 22 minutes, tells the story of water and its control from small watershed developments to the great flood-control structures on our important rivers. Much of the film is devoted to large projects, including dams, flood channels, flood walls, bank revetments, and floodway diversion structures. The hydrologic cycle is explained in animated scenes. There is also a short sequence explaining the work of the Waterways Experiment Station at Vicksburg.

Requests to borrow both films should be made to the ASCE Executive Secretary, at Society Headquarters, 33 West 39th Street, New York 18, N. Y.

### ASCE QUARTERLY ENGINEERING SALARY INDEX

**Consulting Firms**

| City | Current | Last Quarter |
|---|---|---|
| Atlanta | 1.11 | 1.11 |
| Baltimore | 1.11 | 1.11 |
| Boston | 1.15 | 1.13 |
| Chicago | 1.30 | 1.26 |
| Denver | 1.22 | 1.19 |
| Houston | 1.12 | 1.08 |
| Kansas City | 1.14 | 1.14 |
| Los Angeles | 1.16 | 1.16 |
| New York | 1.20 | 1.17 |
| Pittsburgh | 1.05 | 0.93 |
| Portland (Ore.) | 1.15 | 1.15 |
| San Francisco | 1.19 | 1.17 |
| Seattle | 1.06 | 1.07 |

**Highway Departments**

| Region | Current | Last Quarter |
|---|---|---|
| I, New England | 0.91 | 0.85 |
| II, Mid. Atlantic | 1.17 | 1.17 |
| III, Mid. West | 1.25 | 1.15 |
| IV, South | 1.09 | 1.07 |
| V, West | 1.00 | 0.97 |
| VI, Far West | 1.15 | 1.15 |

Figures are based on salaries in effect as of May 15, 1958. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $13,930.

## 1958 "Transactions" Ready

Since its inception in 1872 the ASCE TRANSACTIONS has been a repository for all the important developments in the civil engineering field. Now Volume 123 (for 1958) is ready to take its place as the latest in the long and distinguished series. This necessary addition to every technical library contains 1,281 pages, composed of 68 papers and 76 individual discussions.

For members of ASCE the 1958 TRANSACTIONS is priced at $2.00, $3.00, and $4.00, in paper, cloth, or morocco-grained binding. For non-members the price range is $16.00, $17.00, and $18.00, depending on the choice of binding.

For convenience in ordering a coupon has been provided in the advertising section of this issue (page 157).

## United Engineering Trustees Elect New Officers

Andrew Fletcher, president of the St. Joseph Lead Company, has been elected president of United Engineering Trustees, Inc. Mr. Fletcher is a former president of the American Institute of Mining, Metallurgical, and Petroleum Engineers, and in 1957 he was awarded the Charles F. Rand Gold Medal of that society for "distinguished administration in non-ferrous mining and metallurgical enterprises." He succeeds Walter J. Barrett, of the New Jersey Bell Telephone Company, who has been president of UET since 1955.

Other new UET officers are George W. Burpee, M. ASCE, and Willis F. Thompson, vice-presidents; Charles B. Molineaux, M. ASCE, treasurer; and Steven W. Marras, secretary-general manager.

UET was incorporated in 1904 for the purpose of advancing the engineering arts and sciences. It owns and administers the present Engineering Societies Building and will serve in a similar capacity in the administration of the new United Engineering Center.

### ASCE Membership as of November 10, 1958

| | |
|---|---|
| Members | 10,203 |
| Associate Members | 14,311 |
| Junior Members | 17,532 |
| Affiliates | 76 |
| Honorary Members | 46 |
| Total | 42,168 |
| (November 8, 1957 | 40,792) |

## Back Issues of "Transactions" Available

Many members do not know that the Society carries a stock of back-dated TRANSACTIONS in mint condition for sale to fill out reference sets. Some new volumes are available as far back as 1867, including cumulative indexes for the entire publishing history of TRANSACTIONS. Prices are given in the 1958 Official Register (page 97).

The Society also assists members who wish to donate their sets and those who are anxious to acquire old sets. Donors customarily require only that the recipient pay the cost of packing and shipping, and the arrangement between donor and recipient is direct. While the Society does not have the facilities for receiving old sets and holding them for reshipment, it does all in its power to bring together those needing sets and those able to supply them.

## "Seven Wonders" Plaque for Empire State Building

**Formal ceremonies honoring the Empire State Building as one of the Seven Modern Civil Engineering Wonders of the United States took place in October on the Building's 85th floor. Here Robert Crown, president of the Empire State Building, receives bronze plaque from Louis R. Howson, then president of ASCE. The structure was cited as "The Queen of Skyscrapers."**

## Construction Division Has New Executive Committee

**New personnel of Construction Division Executive Committee plans expansion program. Chairman Walter C. Couse proposes new schedule of operations to Michael N. Salgo, secretary, Joseph F. Jelley, Jr., Alexander Brest, Lyman D. Wilbur and Don P. Reynolds, of the ASCE headquarter's office.**

## Nearly 1,000 Sanitary Engineers Now Certified

At a recent meeting of the board of trustees of the American Sanitary Engineering Intersociety Board, 100 additional engineers were accepted for certification. All certified engineers automatically become diplomates in the American Academy of Sanitary Engineers. This brings the total number of diplomates to 979. Of those previously certified 555 were qualified through specialization in water supply and waste water disposal, 198 in public health, 31 in industrial hygiene, 10 in air pollution control, and 5 in radiation hygiene and hazard control. An additional 80 had qualified in the general field of sanitary engineering.

Thomas R. Camp, M.ASCE, Boston, Mass., consultant, was reelected chairman of the ASEIB, and R. E. Lawrence, M.ASCE, consulting engineer of Kansas City, Mo., was reelected vice-chairman. R. S. Rankin, M.ASCE., of Stamford, Conn., was reelected treasurer. Mr. Rankin was also elected secretary to replace Francis B. Elder, M.ASCE who has resigned.

**Francis B. Elder (left), who is retiring as secretary of the ASEIB after three years in the post, greets his successor, R. S. ("Steve") Rankin.**

Special action taken included authorization of publication of the first roster in January 1959. A much debated question relative to the specialty listings to appear on certificates was resolved by authorizing issuance of certificates bearing the specialty designation, "Sanitary Engineer." Anyone previously issued a certificate showing a specialty will be allowed to exchange it free of charge, for one inscribed, "Sanitary Engineer."

Letters of commendation were prepared for two retiring members of the Board: Col. W. A. Hardenbergh in recognition of his long service ending in the establishment of the ASEIB and the American Academy of Sanitary Engineers, and to Mr. Elder for his work as secretary of the ASEIB during its first three years.

## New Manual on Private Practice Ready for Distribution

An entirely new "Manual on the Private Practice of Civil Engineering for the Use of Engineers and Clients" has been approved for publication by the Board of Direction. This comprehensive publication, to be known as Manual 38, will be ready for distribution soon after the first of the year. It can be obtained by using the coupon in the advertising section of this issue.

The new manual has been in preparation by the Committee on Professional Practice of the Society's Department of Conditions of Practice since early in 1957. It will replace Manual 29 which has been the authoritative Society publication since 1951. Manual 38 is the most complete document on the subject ever issued by the Society. Every civil engineer in private practice will find it a useful guide to his duties and the relationships between himself and his clients. He may wish to acquaint his clients with its contents.

Subjects covered include: How to negotiate for the services of an engineer; what services the engineer is expected to render; what to include in the contract between engineer and client; a description of eight commonly accepted bases for making charges; a discussion of the usual overhead expenses of an engineer's office; method of estimating fees; the work covered by fees taken from the fee curves; how to arrive at the total cost of a project; and finally a chapter on fees for freeway projects representing the "composite experience and viewpoint of civil engineers interested in this phase of engineering."

The manual points out anew that it is a violation of the Code of Ethics to invite proposals or state a price for engineering services on a competitive-price basis. It states further that, "engineering service on a contingent basis is considered unsound and an unethical business practice."

The manual notes that charges for professional services may be based on one of the following methods or combination of methods: Percentage of cost; fixed-lump sum; cost-plus-a-fixed fee; direct salary cost times a factor plus incurred expense; per-diem or hourly rates; retainer fee; or retainer plus per-diem. Each of these methods has special application. These are elaborated in Manual 38, together with an explanation of the payments ordinarily made in addition to the percentage fee. "The curves for median fees shown in Fig. 1 of the manual are . . . for engineering practice within the continental United States . . . They are not the same as those in former Manual 29. They are slightly lower at $100,000 of construction cost, . . . slightly higher at $1,000,000, . . . and have been extended to $100,000,000." Projects costing less than $100,000—there are thousands of them—are so varied and often so complicated in their requirements that they are not covered by the curves. Fig. 1 applies to usual engineering projects, with curve A applying to projects of above-average complexity and Curve B to average projects. It is suggested that the manual be studied before the curves are used.

Because of the size and importance of the present highway program, the subject of suitable fees for professional engineering services in connection with it, is discussed in detail in the new manual. The committee was favored with the cooperation of a number of state highway engineers and consulting engineers with broad experience with the highway program. Their views are reflected in the section of the manual covering freeway projects. Fig. 2 is applicable to freeway projects with adjustments to be made according to the nature of the services.

The chairman of the 1957 committee was Herbert C. Gee; of the 1958 committee, Lloyd D. Knapp; and of the subcommittee on freeway projects, Louis R. Howson. Gustave Requardt served on all these committees, and is given great credit by Past-President Howson for his work in assembling and preparing the draft of Manual 38.

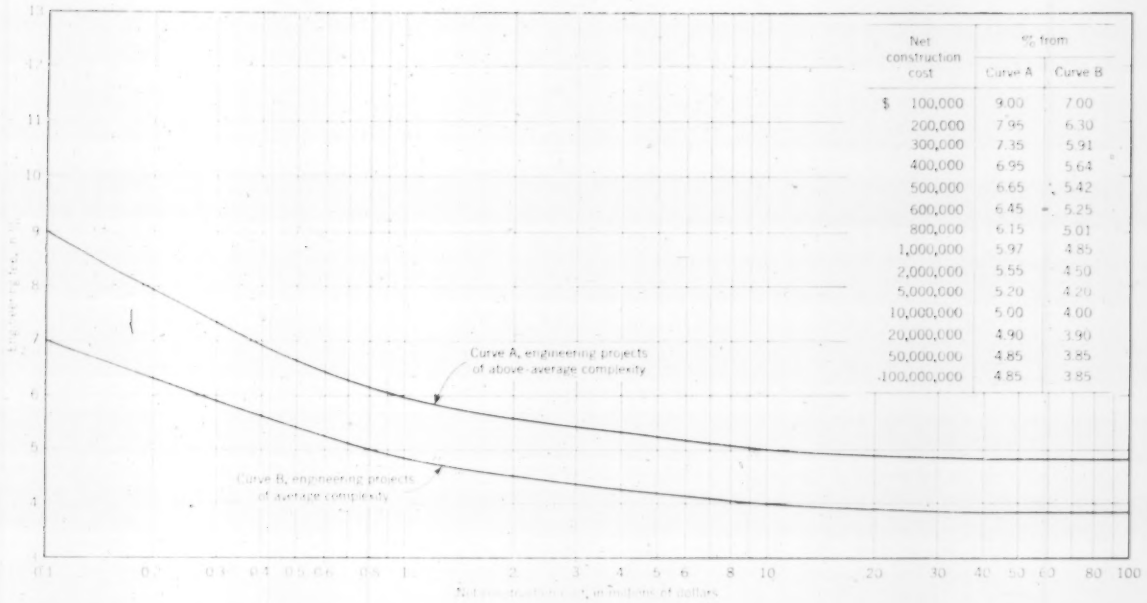



Fig. 1. Median fees for professional services, described in Chapter VII of Manual 38, in percentage of construction cost. These fees are to be adjusted to suit special conditions. The text of Manual 38 should be consulted before using these curves.

**As we go to press final approval of the curves of Fig. 2 has not been received.**

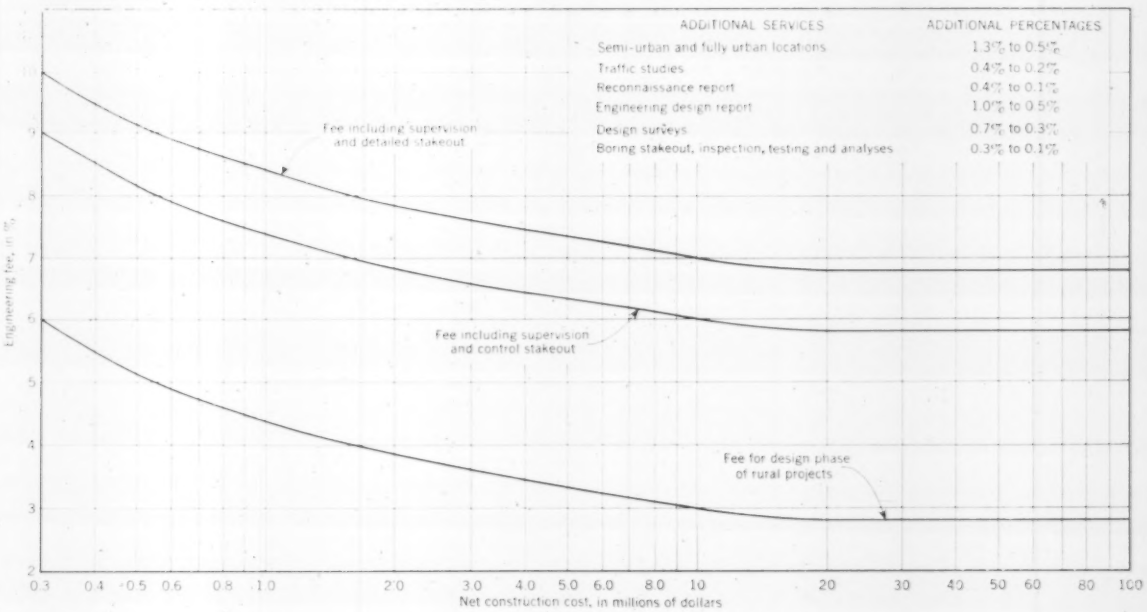
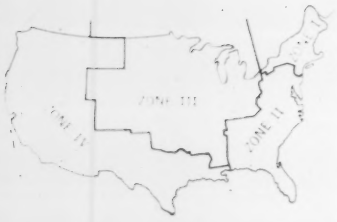

ADDITIONAL SERVICES
ADDITIONAL PERCENTAGES
Semi-urban and fully urban locations 1.3% to 0.5%
Traffic studies 0.4% to 0.2%
Reconnaissance report 0.4% to 0.1%
Engineering design report 1.0% to 0.5%
Design surveys 0.7% to 0.3%
Boring stakeout, inspection, testing and analyses 0.3% to 0.1%
Fee including supervision and detailed stakeout
Fee including supervision and control stakeout
Fee for design phase of rural projects
Engineering fee, in %
0.3 0.4 0.5 0.6 0.8 1.0 2.0 3.0 4.0 5.0 6.0 8.0 10 20 30 40 50 60 80 100
Net construction cost, in millions of dollars

Fig. 2. Basic fees for minimum services on rural freeway projects as a percentage of net construction cost. They do not apply to complex bridges, the fee for which is computed and paid separately. The percentages are to be increased for the additional services cited. The text of Manual 38 should be consulted before using these curves.




# The Younger Viewpoint

## The Voice of the Committee on Junior Member Publications

*One of the pet theories of your chairman is that the weakest link in the chain of success and value for any organization is that of communication. When there is no communication—or too little—the organization suffers from lack of true representation. This viewpoint, held by many, is the primary reason for this page in "Civil Engineering." Here, Junior Members, you have a convenient and, possibly, powerful means of communication.*

*Please use this page! Let us know your ideas and opinions and let us publish them. This page is your opportunity! Your committee is currently concerned about inadequate response to it. This page must become your voice, or its purpose will not be fulfilled and efforts to retain it will not be justified.*

**Committee on Junior Member Publications**

**Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.**

| Zone I | Zone II | Zone III | Zone IV |
|---|---|---|---|
| Louis K. Walter, Jr.<br>320 Market Street<br>Kenilworth, N. J. | Raymond S. Gordon<br>State Planters<br>Bank Building<br>Richmond, Va. | Walter D. Linzing<br>4751 No. Paulina<br>Chicago 40, Ill. | Rodney P. Lundin<br>9744 Quakertown Ave.<br>Chatsworth, Calif. |


Did Tennyson speak your mind when he wrote: "So many worlds, so much to do, so little done, such things to be."

Or maybe it was Johnson when he said: "Every man is, or hopes to be, an Idler."

We hope you agree with Homer: "Light is the task where many share the toil."

Junior Members came into their own at the Conference on Electronic Computation held in Kansas City on November 20 and 21, when five of them were principal speakers on the Conference program.

We are indebted to Charles Heidengren, J.M. ASCE, for the following report on Junior activities in the Metropolitan section (Harry Rode, president of the Junior Member Forum):

The civil engineering profession has been occupied with the question of securing its professional standing with the public. Today, the civil engineer finds himself in a unique position, both in his job in many widely diversified fields, and as a member of his community. In order to establish himself on a level of prestige equivalent to that of the medical and law professions the engineer must understand and practice "human engineering" and aspects of life outside the strictly technical ones.

In its program for the year 1958-1959 the Junior Member Forum of the Metropolitan Section of ASCE will attempt to follow a non-technical theme. Topics for the coming months will include: Personnel Evaluation and Salary Administration; Organization of Civil Engineering Work; Professionalism; and a panel discussion entitled "Why I Left Civil Engineering."

The success of the dinner meetings held last year has prompted the planning of four similar meetings as part of this year's program. An informal and congenial atmosphere and the opportunity to meet other Junior Members on a more social basis should provide an enjoyable evening for all who attend.

The activities of the Junior Member Forum will once again include a Technical Soils Seminar Group and the New York State P.E. Review Course. There will also be several field trips to an interesting plant or project easily accessible to the Metropolitan area.

It is hoped that all Junior Members of ASCE in the Metropolitan area will participate in any or all of the activities. Young engineers from anywhere in the world who may be spending time in New York are also urged to attend the meetings and activities.

What's going on in your Section?

You will want to be certain that you and all your associates vote on the forthcoming "grade change" ballot. One of the keystones of your professional status is involved.

Your chairman had the pleasure of meeting Committee Members Linzing and Walter at the Annual Convention this October. One of the conclusions coming out of the meeting was that the editorial responsibility for this page would be rotated through the committee on a monthly basis. Next month Walter Linzing, of Zone III, will carry the ball.

### WANTED

Professionally-minded young man in Zone II to take up this committee membership. Now available due to the necessary resignation of Ray Gordon. Please apply by letter soon to Chairman Alpern.

***REWARD:*** A Better Profession

As a final reminder to all who read this column, your committee quotes: "It is better to wear out than to rust out."

Greetings of the season.

# NOTES FROM THE LOCAL SECTIONS

*(Copy for these columns must be received by the fifth of the month preceding date of publication)*

Secretary William H. Wisely spoke at the first fall meeting of the **Georgia Section** in September, explaining and discussing activities at Society Headquarters. After the question-and-answer session at the end of Mr. Wisely's talk, the Section presented him with an invitation for the Society to hold its Spring 1963 Convention in Atlanta. Getting to the root of things at the **Albany Branch's** meeting, Prof. G. F. Sowers, of the Georgia Institute of Technology, spoke on the problems of foundations engineers. There were a number of out-of-town guests at the meeting.

With an eye to encouraging Student Chapter members in Society activities, the **Hawaii Section** has set up an essay contest among University of Hawaii engineering underclassmen. Entrants must be Student Chapter members and the closing date for the contest each year will be October 31. The subject for the essay will be chosen by the Section's Junior Members Committee and the award will be $100.

At the annual joint meeting of the **Northwestern Branch of the Indiana Section** and the Student Chapter at Notre Dame University, members and students heard Dr. C. E. Cutts, head of the civil engineering department at Michigan State University, speak on "Research and Civil Engineering." Dr. Cutts stressed the demands that will be put on civil engineers in scientific developments of the future.

Several visitors from abroad enlivened the **Kansas Section's** September meeting. Two Australian engineers were guests at the meeting and Moshe Barouch, a native of Israel, was the speaker. Mr. Barouch discussed the problems involved in supplying water to his growing country. His description of rainfall patterns, hydrologic features, and proposed projects stirred up much interest among the members, and a lengthy question-and-answer period followed.

In September, members of the **Los Angeles Section** heard a talk designed to help them keep up with the rapid changes taking place in the world today. Dr. Hans Freidrich spoke on "Our Place in Space," supplementing his lecture with a newly-released movie on the launching of the Atlas missile. In Dr. Freidrich's opinion, man, with his increasing technical skill, will eventually conquer space.

At the **Maryland Section's** first meeting of the season members discussed the advisability of adding more officers to keep pace with the growth of the Section. An assistant secretary-treasurer and two elected directors will be added after the necessary constitutional changes have been made. The speaker was Robert E. Derby, president of Albert C. Wood Associates, consulting engineers. Mr. Wood discussed steel and electric power installations for industry and for municipal and federal government.

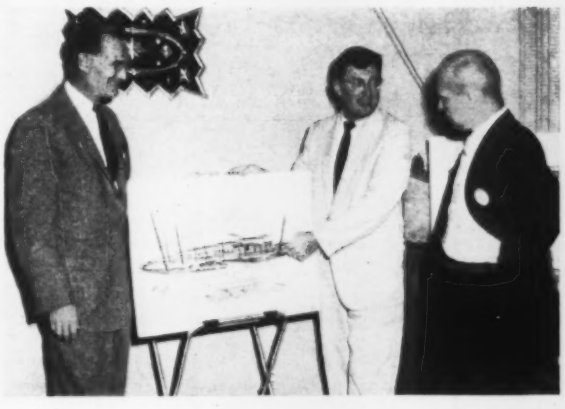
At a recent joint meeting of the **Metropolitan Section** and the Construction Specifications Institute, members heard a lively panel discussion on "Specification Headaches." Harold Sleeper, of the New York City Board of Appeals, was moderator for the panel which consisted of: R. K. Abrams, of the Port of New York Authority; A. C. Holden, architect; Eugene Rau, of the J. Rich Steers Corporation; and J. J. White, of Parsons, Brinckerhoff, Hall & Macdonald. The attitudes of a lawyer, an architect, a constructor, and a consultant were presented. The "or-equal" clause in specifications was considered unnecessary and confusing. There was talk of creating a committee for specifications writers in the Construction Division.

New officers of the **Philadelphia Section** are: Maj. Gen. Harry B. Vaughan, Jr., (Ret.) president; Alfred A. Estrada, vice-president; Clyde B. Pyle, secretary; Neville C. Courtney, treasurer; and Theodore Davis, membership secretary.

Realizing the value of confident and articulate self-expression, the Speakers Club of the **Sacramento Section** attempts to increase members' ease in oral communication. The club, which has been in existence since 1941, has a professional speech consultant lecture to its members once a month. Members who have participated are enthusiastic about this chance to learn to speak and to express themselves more effectively.

Society news was the order of the day at the **San Diego Section's** September meeting. National officers President Howson, Director Finley Laverty, and Director R. Robinson Rowe were guests at the meeting. Mr. Laverty discussed briefly the functions of the Southern California Industry-Education Council. Mr. Rowe asked for early submission of views from Local Sections on revising Zones and Districts. President Howson reviewed the current major Society activities.

A Carolina moon shone on members of the **South Carolina Section** at their annual convention in Charleston, which took the form of a tour of the U.S. Naval Base there and a moonlight boat ride. Three co-chairmen for the Section's UEC fund drive were named. They are T. A. Able, Jr., northwest section; T. Keith Legare, central section; and L. K. Himelright, southern section.



**Architects and engineers join to discuss mutual problems at joint meeting of Orange County Branch of Los Angeles Section and American Institute of Architects. Shown here are (left to right) William Jordan, president of AIA Branch; Wayne Williams, AIA speaker; and Chester Schultz, president of Orange County Branch.**

Toledo Section holds joint dinner meeting with local groups of the Founder Societies and the Toledo Society of Professional Engineers. Meeting theme was professional unity. The speakers were Julius Strasbourger (right), representing AIEE; ASCE Assistant Secretary E. Lawrence Chandler (at the lectern); Sidney L. Stolte (left), representing NSPE; and Arthur B. Heiberg, representing the ASME, not shown.

Some of the new Montana Section officers confer at Section's annual meeting held at Billings in October. Section President Leland Walker (center) is flanked, on the left, by Walter Boettcher, vice-president for the Billings Branch, and on the right by Harry Balmer, vice-president for the Great Falls Branch. Not shown are Secretary-Treasurer George Herman and Paul Poirier, vice-president for the Helena Branch.

## LOCAL SECTION MEETINGS

**Hawaii**—Post-Convention Tour of the Islands, February 16-25. Tour headquarters will be the Reef Hotel, Honolulu. For information write, Reservations Committee, P. O. Box 8084, Honolulu, Hawaii.

**Illinois**—Weekly luncheon meeting at the Engineers Club, Chicago, every Friday at 12 noon.

**Los Angeles**—San Bernardino-Riverside Counties Branch reception and dinner at Mike's Grill, December 16 at 6:30 p.m. (for reservations write L. A. Coleman, P. O. Box 697, Cucamonga, Calif.); Santa Barbara-Ventura Counties Branch, annual meeting at the Pierpont Inn, December 16, at 7 p.m. The Construction Group, Soil Mechanics Group, Transportation Group, and Orange County Branch will omit their December meetings.

**Metropolitan**—Meeting at the Engineering Societies Building on December 17 at 7 p.m.

**Philadelphia**—Presentation of life membership certificates and discussion on the New Orleans Bridge, at the Engineers Club on January 13, at 7:30 p.m.; meeting on the Problems of Design and Construction in the Arctic, at the Engineers Club on February 10, at 7:30 p.m.

**Sacramento**—Weekly luncheon meeting at the Elk's Temple every Tuesday at 12 noon.

**Syracuse**—Regular monthly dinner meeting at Drumlins, December 16, at 6:30 p.m.

**Virginia**—Norfolk Branch meeting the third Monday of every month at the YMCA Cafeteria at 12 noon; Richmond Branch meeting the first Monday of every month at the Hot Shoppe Cafeteria at 12:15 p.m.; Roanoke Branch meeting the second Wednesday of every month in the S & W Cafeteria at 6:30 p.m.

Discussing plans for new Central Pennsylvania Section are, in usual order, Executive Secretary Wisely, first Vice-President R. H. Klucher, and Section President Fred Morgenthaler, Jr. This was first formal meeting of the group since Branch became Section.

## ASCE CONVENTIONS

**LOS ANGELES CONVENTION**

Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

**CLEVELAND CONVENTION**

Cleveland, Ohio
Hotel Cleveland
May 4-8, 1959

**ANNUAL CONVENTION**

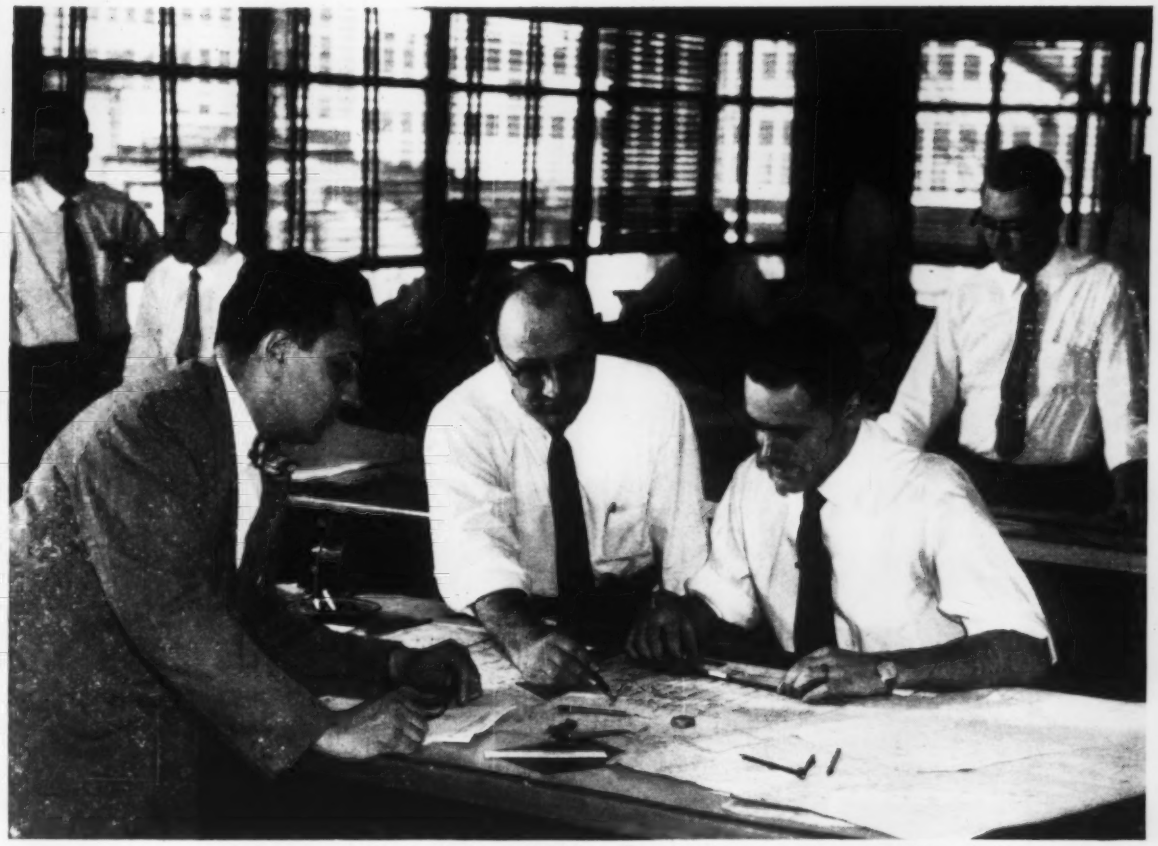
Washington, D. C.
Hotel Statler
October 19-23, 1959

## TECHNICAL DIVISION MEETINGS

**JET AIRPORT CONFERENCE**

Houston, Tex.
Shamrock-Hilton Hotel
May 20-22, 1959

*Sponsored by*
ASCE Air Transport Division
Houston Branch of
Texas Section



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# BY-LINE WASHINGTON . . . . .

**There will be plenty of work for civil engineers** in the huge construction programs the Democrats expect to draft when Congress convenes in January. Majority Leader Lyndon Johnson feels that the landslide vote for Democratic Congressmen in the November elections indicates that the American people want "full-speed-ahead" on mammoth federal-aid spending programs. High on the legislators' list of priorities will be the once-vetoed community facilities plan, urban renewal, airports and water resources development. The hopper will be full of federal-aid proposals to launch long-range, multi-billion-dollar programs.

*President Eisenhower, sensing the way the wind blows,* has already cautioned strongly against "wild spending" and will undoubtedly oppose some of the most ambitious plans.

*The Administration will support* an alternate water pollution control program, which it claims will induce low-income states to accept financial responsibility for their own sewage treatment construction programs. Officials would have the federal government rebate to the states 40 percent of the revenue from the 10 percent federal tax on local telephone calls to help finance this kind of work. This scheme would make $145 million a year available to the states, far more than the $50 million currently apportioned for this kind of construction.

* * *

**Dire predictions and rumors about a "so-called" shortage** of engineers are a disservice to the nation and the engineering profession, the National Society of Professional Engineers has declared. NSPE has issued an appeal that all communications media "weigh carefully the facts, and soberly analyze those facts, before starting a new wave of publicity to the effect that the nation faces a severe engineering manpower shortage." The society has aligned itself against federal scholarship proposals which would stimulate an increase in engineering enrollments, without at the same time upgrading the quality of instruction. The chief answer to the threat of an engineering shortage, NSPE claims, is greater utilization of existing engineering manpower.

*To head off possible future shortages of highway engineers,* however, a joint committee of the ASCE Highway Division and the American Association of State Highway Officials has published a booklet entitled "A Career for You in Highway Engineering." The Automotive Safety Foundation here in Washington underwrote the initial printing run and will handle requests for more information (200 Ring Bldg., Washington 6, D. C.). Organizations desirous of placing copies in the hands of local high school students may obtain quantities at cost, ASF reports. This is the first real vocational information piece developed for general distribution to high school students, ASF reports.

* * *

**How much public works construction is involved** in the national urban renewal program? Plenty, according to Joseph H. Ehlers, M. ASCE, Assistant Commissioner of the Urban Renewal Administration. His analysis of 122 projects reveals that the federal government will pay $674 million of the total $1 billion costs. And of this federal share, 25 percent (or $177 million) will be needed to help pay for public works construction. Streets and highways will call for 33 percent; schools, 25 percent; sewers, 9 percent; parking facilities, 9 percent; and parks and playgrounds, 6 percent.

*Ehlers cites a large Philadelphia undertaking* as an example. On this huge 2,500-acre project, grading will cost $10 million; 600 acres of streets, sidewalks, and curbs will come to $16 million; bridges, $2 million; sewer and water systems, $5 million; and parks and playgrounds, $4.5 million. The storm drainage system will contain 40 miles of 15 to 60-in. concrete pipe and nearly 5 miles of culverts up to 8 x 10 ft. The sanitary sewer system will involve 54 miles of vitrified clay pipe from 20 to 24 in. in size. The water system will call for 52 miles of 8 to 30-in. cast-iron pipe and 418 fire hydrants.

So the tendency to think of urban renewal as merely replacement of housing—and as an architectural problem—can be misleading.

* * *

**Engineers will bring $134.5 million worth of new construction** to the contract-awarding stage during the next eight months for the U. S. Bureau of Reclamation, the agency announced last month. Although the bulk of the Bureau's $213-million program for fiscal 1959 will be to continue projects already begun, some 90 more starts will be made between now and June. The new work envisioned includes six earthfill dams (having a total volume of about 14,000,000 cu yd), 446 miles of transmission lines, 13 pumping plants, 50 miles of pipelines, 176 miles of laterals and drains, 50 miles of roads, 110 miles of canals, 30 miles of river channelization, and 2 powerplants.

* * *

**The $600-million emergency highway program** created as a special anti-recession measure last session is right on schedule. Bureau of Public Roads officials report that all the funds have been obligated by construction contracts. A total of 12,050 miles is under construction, all of which is over and above the regular Federal Aid Primary, Secondary and Urban program. Projects must be completed by December 1959.

* * *

**The U. S. Civil Service Commission** has issued a new recruitment booklet, "Flexibility in the Federal Personnel System," which follows recommendations made by the President's Committee on Scientists and Engineers. The publication is intended to advise federal agencies of recruitment possibilities under the examining system.

* * *

**Roadbuilding costs have dipped,** the BPR reports, although this may well be just a temporary lapse in the inflation spiral. Bid prices fell off 1.7 percent from the second quarter level.

*Thirty more miles of concrete pipe were added to Milwaukee's sewer system in 1957, most of it 8" I.D.*

## *In Milwaukee...*

# the entire residential sewer system is concrete pipe

Concrete pipe was chosen by Milwaukee in 1923 for its new residential sewage collecting system. All submains and mains have been included in this continuing program. Performance record? Not a single failure attributed to the pipe where it has served residential use.

That's because concrete pipe has uniformly high strength right from the start...and because concrete, by its very nature, grows stronger year by year.

Milwaukee chose concrete pipe because it meets the requirements of uniformity of strength—strength to carry all the loads—durability, availability and low initial cost.

Add maximum hydraulic capacity and long life. Put all these advantages together and it's easy to see why more and more municipalities are finding concrete is the answer to low-cost, trouble-free pipelines. Write for free literature, "*Concrete Sewers*," distributed only in the U.S. and Canada,

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*A national organization to improve and extend the uses of concrete*

**FOR ALL MODERN PIPELINES**

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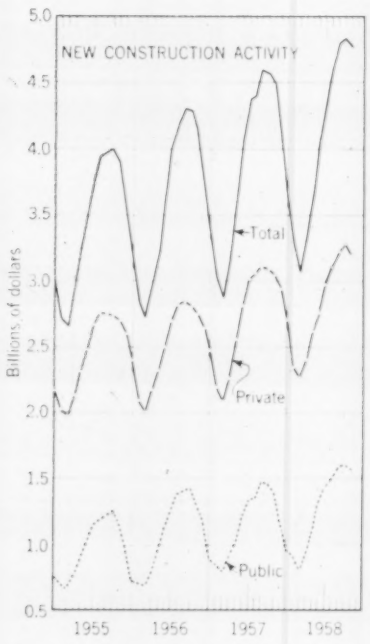
# NEWS BRIEFS . . .

## Construction Activity Remains Strong in October

New construction activity showed better-than-seasonal strength in October, and the dollar value of work put in place practically equalled the record $4.8 billion spent in August and September, according to preliminary joint estimates of the U. S. Departments of Labor and Commerce. Outlays for the first ten months of 1958, at $4.1 billion, were up 2 percent from the comparable period of 1957.

Thus far in 1958 private expenditures, amounting to $28.3 billion, almost matched the 1957 all-time high for the ten-month period. Improvement over the year in homebuilding and gains in many types of nonresidential construction were offset by a sharp decline in private industrial building. The $12.8 billion spent for publicly owned construction during the period was up 6 percent from the comparable period of 1957. Highways and public housing contributed most of the gain in this area.

These joint estimates are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. Except when special surveys are made, the estimates do not reflect the effects of varying numbers of working days in different months, nor of special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements. Other indicators of future trends are housing starts, contract awards, building permits, and materials output.




**Dollar value of construction put in place in October equals record $4.8 billion spent in August and September.**

## New York and Idaho Men Honored by Moles Awards

James F. Armstrong, A.M. ASCE, of New York City, and John Bruce (Jack) Bonny, of Boise, Idaho, have been named the 1959 winners of The Moles annual awards for "outstanding achievement in construction." The award, considered the highest accorded service to the American construction industry, is given annually to one Moles member and one nonmember.

Mr. Armstrong, the member winner, is vice-president of the Peter F. Connolly Company. He has been in heavy construction for more than half a century, with much of his work in the field of pneumatic caissons for bridge foundations. He has been associated with the Arthur McMullen Co., Senior & Palmer, Inc., and the Walsh Construction Co. on some of the most important bridge installations in the metropolitan area. Mr. Bonny is vice-president and general manager of the Morrison-Knudsen Company, Inc., which carries on world-wide operations from its Boise, Idaho, headquarters. Since 1952 he has been virtually "commuting" between this country and French Morocco, Iran and Iraq, and in this hemisphere, he flies more than 200,000 miles a year, often as relief pilot in the DC 3 assigned to him. He is a graduate of the University of California, and has been with Morrison-Knudsen since 1931.

**J. F. Armstrong**

**J. B. Bonny**

Messrs Armstrong and Bonny are the nineteenth pair honored in a series that started in 1941 and numbers among its winners former President Herbert Hoover, Robert Moses, Peter Kiewit, and Harvey Slocum. Formal presentation of their honors will take place at the annual Moles' Awards dinner at the Waldorf-Astoria next January 28.

## England Plans Big Expressway System

In the face of growing criticism of England's outmoded and outdated highways, the British Government is making plans for an extensive and costly system of expressways. Top priority is being given to a series of projects that are expected to alleviate traffic congestion. One of these will be a by-pass on the London-Exeter route. Built on an embankment two miles long, the project will cost about $2,800,000 a mile. Five other high-priority projects are:

1. Construction of 168 miles of dual highway between London and Newcastle.
2. Construction of a 95-mile highway between Birmingham and the southern terminus of the Preston By-pass (a recently opened eight-mile stretch of dual highway).
3. Improving trunk roads and building some dual three-lane highways between London and the Channel ports.
4. Modernizing the highways from the Midlands to South Wales, partly by laying new roads on recently abandoned railway roadbed.
5. Building an expressway running westward out of London to London Airport, western England, and South Wales.

Organized road users, including commercial haulers and automobile clubs, have based their case for better roads on the fact that, "The cost of road congestion in England—in wasted time and fuel and wear and tear—amounts to $1,400,000,000 a year." In 1956, these groups note, motor vehicles traveled 25,000,000,000 miles in urban areas at an average speed of 20 mph and 30,000,000,000 miles in rural areas at 32 mph.

## Contract Awarded for Potomac River Bridge

The U. S. Bureau of Public Roads has awarded a $2,375,760 low-bid contract to the Pittsburgh-Des Moines Steel Company, of Pittsburgh, Pa., for constructing the east and west approach superstructure of the Woodrow Wilson Memorial Bridge over the Potomac River. The new bridge, which crosses the Potomac from Alexandria, Va., to Maryland, will be a key link in the Washington, D. C., Circumferential Highway. It will be 1⅛ miles long.

The contract covers three-quarters of the entire elevated structure, the balance consisting of a bascule span over the navigable channel. The project will include four lines of welded girders for a 75-ft-wide floor. Completion is scheduled for May 1, 1960.

## Steel Production Rises in October

A sharp rise in steel production for October is announced by the American Iron and Steel Institute. The output of 8,816,000 tons of ingots and steel for castings represents an increase of 1.2 million tons over September production. It is also the largest monthly output since October 1957 and the first month this year when production reached 8,000,000 tons. Production for the first ten months of the year was 67,885,267 tons, compared with 96,901,792 tons in the corresponding period of last year.

On the basis of the industry's rated annual steelmaking capacity (as of January 1, 1958) of 140,742,570 tons, the steelmaking facilities of the nation were utilized at 73.8 percent of capacity in the October just past. The percentage of capacity for the first ten months of 1958 was 57.9 percent.

## Portland Cement Dedicates New Structural Laboratory

This fall the Portland Cement Association unveiled a new Structural Laboratory of precast concrete that may revolutionize the design of structural testing laboratories of the future. The laboratory is in itself a giant testing machine, capable of exerting a test load of over 10,000,000 lb. The structure features a 56 by 120-ft test floor, designed to act as a hollow concrete box girder in the longitudinal direction and a Vierendeel girder in the transverse direction. The overall depth of this girder is 12 ft with the first-floor slab joined to the basement floor slab by 8½-ft-high webs. The first floor slab is pierced by 690 holes, on 3-ft centers, by means of which test specimens are secured and loads applied. All test loads are produced by hydraulic jacks.

The design assures the laboratory almost unlimited flexibility. Any structural element from a short girder to a full-size floor slab or roof shell can be loaded to destruction. For example, a slab can be subjected to local loads as high as 30,000 psf, and a slab the size of the entire testing floor can be subjected to a load of several thousand pounds per square foot over its entire area.

The test floor was designed by Eivind Hognestad, M.ASCE, manager of the Portland Cement Association's Structural Development Section.

## Greater New Orleans Bridge Is Dedicated

Dedication ceremonies for the Greater New Orleans Bridge across the Mississippi were held at the New Orleans toll plaza on October 18. ASCE was represented at the ceremonies by former Vice-President Norman Moore, of Vicksburg, Miss. The bridge has been open to limited traffic since April 15.

The new crossing, which connects New Orleans with Algiers, spans the Lower Mississippi farther downstream than ever before. With a 1,575-ft main span, it is the longest cantilever bridge in the United States and the longest cantilever ever built for highway use. The only two cantilevers that exceed it in length are the Quebec Bridge, with a main span of 1,800 ft, and the Firth of Forth Bridge, with two 1,710-ft spans. The Greater New Orleans Bridge also has the distinction of being the longest bridge erected entirely by the cantilever method without falsework supports for the main span. Construction was begun in March 1955.

Modjeski and Masters designed the bridge and facilities and supervised construction for the Mississippi River Bridge Authority. Construction funds were obtained by a $65,000,000 revenue bond issue, supplemented by allocations from state highway funds. O. F. Sorgenfrei, M. ASCE, project engineer on the work for Modjeski and Masters, was the author of an article on the project in the June 1958 issue of CIVIL ENGINEERING (page 60), and Carl B. Jansen, M. ASCE, described the initial work on the pier foundations in the February 1956 issue (page 40).

## *Last Steel Is Placed in Kaiser Center*

**Last structural steel is placed in the new Kaiser Center, which will be the largest office building in the West. The 28-story building—headquarters for the multiple enterprises of Henry J. Kaiser—is the principal structure in a $45 million block-square development in downtown Oakland, Calif. When completed in late 1959, it will provide 1.6 million square feet of floor space.**

## *Preventing Spalling at Glen Canyon Dam*

**Rock anchor bolts are being used along the sheer 700-ft-high walls of Glen Canyon Dam to prevent severe spalling of the pink sandstone—a threat posed by the removal of some 10,000 cu yd of rock from the vertical walls of the canyon at the dam site. Over 1,000 mine roof bolts, 8 and 6 ft long, have been installed to pin back the rock on the west side of the canyon, where spalling was worst. The bolts are ¾-in. Bethlehem Pacific expansion shell-type bolts distributed through the Ross-Cowan Co., of Midvale, Utah. The Merritt-Chapman Scott Corp., of New York, is constructing the $108,000,000 Glen Canyon Dam for the Bureau of Reclamation.**

## Mexico City Host to World Meeting of IRF

Some 1,500 delegates from sixty nations attended the Third World Meeting of the International Road Federation, which was held in Mexico City, October 25-31. In connection with the meeting, the Association of Mexican Equipment Distributors held the largest exhibit of highway equipment ever staged south of the Rio Grande. Both United States and European companies showed their latest models, with some $8,000,000 (U. S. money) worth of equipment on display. The meeting was followed by tours of Mexico's expanding road system and visits to places of interest.

The directors of the IRF's three offices —in London, Paris, and Washington—addressed the opening session on the vital importance of good roads. H. S. Merriam, representing the United States, reminded the group that a nation can produce no more than it can transport. Baron de Woulters, of Paris, emphasized the fact that roads raise the standards of culture and living in areas where they are regional and not national problems. The British delegate stressed the value of IRF as a non-political group not restricted by group interests and pressures. Speaking for the president of Mexico, Secretary of Public Works Walter Buchanan said that the country's new road program increased the national wealth by 2.5 million pesos a year.

Working sessions were devoted to the social and economic aspects of world roads; modern methods of financing new highways; and the technical training of highway engineers.

M. D. Morris represented ASCE at the meeting and presented the Society's good wishes in both English and Spanish. Other Society members attending were Federal Highway Administrator Bertram D. Tallamy, Lawrence T. Beck, Donald Berry, Fred Burggraf, Harmer E. Davis, Irwin Forman, J. H. Gilbert, Emmett H. Karrer, Guy Kelcey, J. Leadabrand, Frank Lilien, Gerald T. McCarthy, Lacey V. Murrow, Radnor J. Paquette, William H. Quirk, A. C. Taylor, Harry Wiersema, Russell Horn, James Morris, Harold McKeever, and Frederick Thompson.

## Cantilever Bridge to Span Panama Canal

A long-discussed crossing of the Pacific end of the Panama Canal will be provided by a three-span cantilever bridge with tied-arch suspended span. Authorized by Congress in 1956, the bridge will speed the heavy flow of interhemispheric traffic now served only by a ferry at Balboa and a swing bridge over Miraflores Locks. The subject of bridges over, or tunnels under, the Canal has been hotly debated since the days when the Canal was being built. The Miraflores swing bridge, opened in 1942, now carries the greater part of the trans-canal traffic, but its location and the delays caused by the ever-increasing marine traffic make it an unsatisfactory solution to the problem.

The site chosen for the new bridge, which will connect La Boca and Balboa, will bring traffic from western Panama to the edge of the City of Panama. Another determining factor in the choice of site is the fact that the Pan-American Highway is scheduled for completion as far as Panama in the next two years, and will ultimately be pushed to a connection in Colombia. The new bridge will cross the present Balboa ferry route at a 40-deg angle.

In November 1957 the Svendrup and Parcel Engineering Company, of St. Louis, Mo., was selected to make preliminary studies and estimates of various alignments and types of structures and to submit a report on the most promising three of the types investigated. In April 1958 the Governor of the Canal Zone appointed a Technical Board of Consultants to review the report in collaboration with Panama Canal Company officials. A cantilever tied arch combination was selected as the most practical of the three types under consideration. The alternatives were a conventional cantilever with simple suspended span and a single-span arch rib. Contrary to expectation, the estimated cost of the tied arch was somewhat less than that of the conventional cantilever, the difference being primarily in the lesser height of the piers.

After review of the plans the firm of Sverdrup and Parcel was authorized to proceed with final design of the tied-arch structure. The cost, including approaches and engineering, is estimated at $23,000,000. Work on the approaches is scheduled to start in January 1959 and on the main structure in July 1959. The tentative date for completion is December 1962.

The project is under the general direction of Maj. Gen. W. E. Potter, M.ASCE, Governor of the Panama Canal Zone. In direct charge is Lt. Col. Robert D. Brown, Jr., director of the Panama Canal Company's Engineering and Construction Bureau, assisted by J. M. Cooke, M.ASCE, designing engineer and head of the company's Engineering Division Elmer B. Stevens, M.ASCE, chief of the Structural Branch of the Panama Canal Company, provided the material from which this item was prepared.

**Three-span cantilever with tied-arch suspended span will bridge the Panama Canal. Work on the approaches will start in January and on the main structure in July 1959.**

## Air Force Academy Nears Completion

Work on the U. S. Air Force Academy at Colorado Springs, Colo., is 90 percent completed and ahead of schedule. Sixty-one major projects have been completed; 21 others are now in process, with twelve of them set for completion by the year's end. The three largest jobs now in progress are the cadet physical education complex, the cadet social center and theater, and 1,200 Capehart housing units. All will be finished next year. The construction labor force is down from a peak of more than 5,500 workers—reached last spring—to about 2,500. According to the Air Force Construction Agency, the construction pace may set a peacetime record for projects based exclusively on competitive bidding.

During the past three years the cadets have been housed at Lowry Air Force Base near Denver. With most basic construction of the Academy now completed, the cadets were able to take up residence there this September.

## New Water Filtration Plant for Cleveland

Cleveland's water supply was increased by 50 mgd with opening of the Crown Filtration Plant this October. The plant —named after Emil J. Crown, director of public utilities for fifteen years prior to his retirement in August—brings the capacity of the Cleveland water system to 515 mgd. The new plant can be expanded to 140 mgd. Located on a 57-acre site in Westlake, the plant will alleviate summer shortages of water in the fast-growing area of Cuyahoga County west of Rocky River.

The cost of the plant and its appurtenances was about $19,500,000. This includes the intake crib, 2½ miles offshore in Lake Erie, and 13,000 ft of 8-ft-dia concrete pipe for moving the water to the shore-shaft, where it is transferred to a 3,600-ft-long concrete-lined tunnel leading to the plant.

Filtered water is pumped to a 15,000,000-gal underground reservoir that has been in use since 1955. The reservoir can be by-passed, with water moving through the pumphouse directly to the distribution mains. An outstanding feature of the plan is the system for handling alum and lime. These dry bulk chemicals, used as an aid to coagulation and for corrosion control, are removed from the cars by a vacuum-tube system.

Havens and Emerson, of Cleveland, were the consulting engineers, and Small, Smith, Reeb and Draz, the consulting architects. The Hunkin-Conkey Construction Company was the general contractor.

## *Huge Dam Under Construction in Africa*

**Kariba Dam and hydroelectric project is under construction on the Zambesi River—the boundary between Northern and Southern Rhodesia—by the Federation of Rhodesia and Nyasaland. Shown here is the main wall of the dam, which will be a concrete arch with maximum height of 420 ft and crest length of 1,900 ft. It will be wide enough to take a 40-ft roadway. The dam will impound a reservoir 175 miles long, covering an area of about 2,000 sq miles. Its total capacity is put at 130,000,000 acre-ft—more than four times that of Hoover Dam. The Kariba hydroelectric project was started in 1955, and first power will go on the line in January 1960. Each of the two underground power stations will house six 100,000-kw vertical-shaft Francis-type turbine generators operating at a 300-ft head, making it, when completed, one of the world's largest hydroelectric developments. Power output per year is estimated at 8,180 million kwhr, which will be distributed to communities and the copperbelt in Northern and Southern Rhodesia by a 930-mile network of transmission lines. The cost of the first stage of the project is estimated at $200,000,000. Three firms, organized as Gibb, Coyne and Sogei (Kariba), serve as consulting civil engineers.**

## *Modernizing Monongahela River Dam*

**Despite delays caused by high water this summer, modernization of Dam No. 8 on the Monongahela River is proceeding on schedule. Under a $2,497,047 contract from the Corps of Engineers, the Dravo Corporation is converting the present fixed crest concrete dam into a movable crest dam. The new structure, located between Point Marion, Pa., and Morgantown, W. V., will raise present pool level about 4 ft. Photo shows cellular steel sheetpile cofferdam, inside which the contractor is carrying out the first stage of the project "in the dry." Completion of the project, which will include a structural steel service bridge across the top of the piers, is scheduled for late 1959.**

## Aluminum Bridge Tested at New York University

A prototype of the Reynolds-Baroni Bridge, a new design in aluminum which permits fast, economical erection from standard prefabricated modular units, was recently demonstrated at New York University by the Reynolds Metal Company and the university's Department of Civil Engineering. Dr. Giorgio Baroni, an engineer known for his pioneer work in thin-shell structures capable of bearing heavy loads, designed the aluminum bridge under sponsorship of the company. The aluminum firm engineered the bridge and fabricated the prototype at its McCook, Ill., sheet mill.

It is expected that the first Reynolds-Baroni Bridge will be erected in Alabama. John W. Chambers, chief bridge designer for the Alabama Highway Department, has notified the firm he is submitting plans and specifications for a 234-ft Reynolds-Baroni Bridge to the Federal Bureau of Public Roads for approval. The bridge will span Big Wills Creek in DeKalb County.

The bridge prototype was erected on the New York University campus, where it is being subjected to severe structural tests conducted by the Department of Civil Engineering. The schedule of tests was planned jointly by the university and Reynolds in line with recommendations of the Federal Bureau of Public Roads.

The demonstration of the thin-shell aluminum bridge was made at the test site before a group of ASCE members foreign engineers in New York for the meeting of the International Association for Bridge and Structural Engineering. E. L. Erickson, chief of the bridge design division of the Bureau of Public Roads, also witnessed the demonstration.

J. Louis Reynolds, executive vice-president of the aluminum firm, described the bridge as competitive with conventional structures in initial cost and much more economical in service because aluminum needs little or no protective maintenance. He noted that with the aluminum components weighing about 10 psf, their lightness materially reduces the substructure required. In fact, the Reynolds-Baroni Bridge will weigh only one-fourth as much as a comparable steel bridge, this weight-saving largely offsetting the lower price of steel.

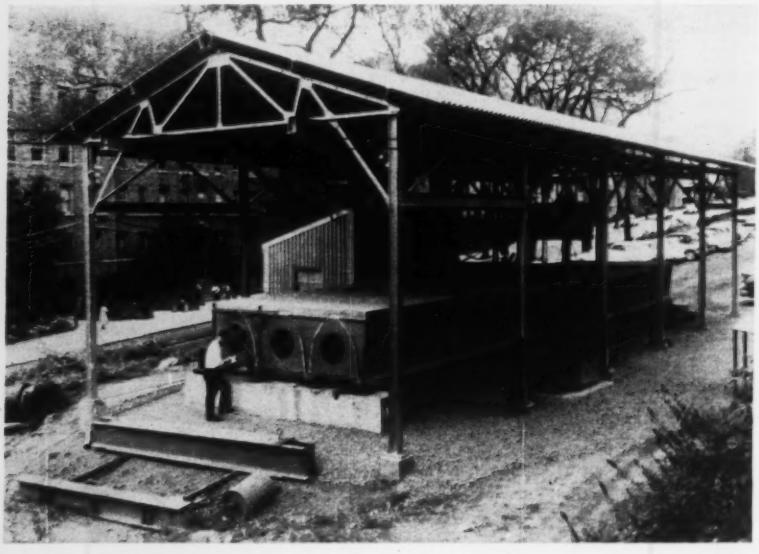
No falsework and little scaffolding are needed for erection. Roadbed concrete can be poured directly on the upper plate, eliminating most of the expensive, time-consuming job of building forms.

The Reynolds bridge consists of parallel parabolic arches stiffened by diaphragms. The 4-ft-wide arches are joined, side to side, to form a continuous roadbed of any multiple width desired. Bridge sections between piers can be in excess of 100 ft long. The main structural joints are welded. The arches and most other components are made of annealed alloy 5083 sheet aluminum. A bridge of almost any size can thus be erected by joining the required modular units, with only minor design changes required. The bridge can be installed with any standard type of abutment and pier.

The prototype structure is 12 ft wide and 60 ft long. In the severe tests to date it has been given dynamic loadings equivalent to the consecutive passage of 400,000 38-ton trucks. This equals the total service demands the bridge would meet in 40 years of normal traffic, but the tests will continue until the equivalent of 100 years of service is passed.

The tests were supervised by James Michalos, M. ASCE, chairman of the NYU Department of Civil Engineering. He was assisted by G. Gerald Kubo, A.M. ASCE, and Charles Birnstiel, J.M. ASCE, of the department.

Dr. Baroni has been a consulting engineer in New York since 1950. He is a native of Italy and a former professor at the University of Milan.



**Prototype of Reynolds-Baroni Bridge undergoes tests at New York University. The hydraulic jack that applies test loadings up to 35 tons on the bridge's one lane can be seen in the center of the span.**

## First Nuclear-Age Disaster Shelter

On October 19 a nuclear-age Control Center for Northeast Illinois and DuPage County was opened at Wheaton, Ill., about 30 miles west of downtown Chicago. The dual-purpose building will house DuPage County Highway Department offices on the ground floor and an intricate disaster control center underground. According to federal authorities, the new control center is the first building in the nation fulfilling Defense Department requirements for withstanding a blast pressure of 30 psi. This means that it could protect its occupants from the blast resulting from explosion of a 20-million-ton hydrogen bomb three or more miles from the center.

The shelter unit has a special 36-in.-thick reinforced concrete ceiling, which was placed in one continuous pour. The walls are 2 ft thick. The two units have completely separate services, so that damage to the highway department floor will not put the Civil Defense Center out of operation. Cooking, storage, and dormitory facilities of the shelter are adequate to sustain an operating staff of 60 for two weeks.

## AWS Establishes Welding Information Center

Establishment of an Information Center for the dissemination of welding news and information is announced by the American Welding Society. An authoritative source for all information related to welding, the service is expected to benefit both the press and industry. The press will be able to check with the Center for technical accuracy, verify news items, and in many cases obtain photos to illustrate material. The Center will be concerned with information relating to the welding industry as a whole; products, equipment, and personnel will be handled by individual companies.

The new Center will be located in the Engineering Societies Building, at 33 West 39th Street, New York 18, N. Y.

# Some Ideas

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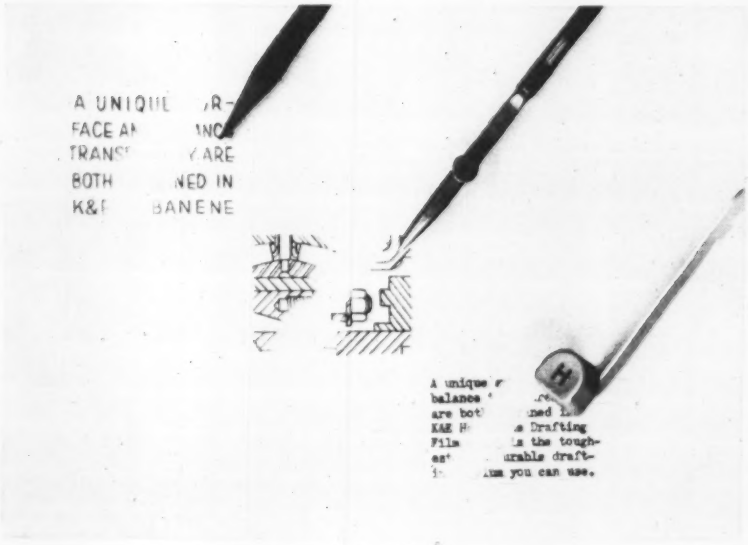

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### About HERCULENE (TM) The Newest of Films

Frankly, we think K&E Herculene Drafting Film is a real discovery. It has all the properties of the K&E "engineered surface" . . . exceptional "take," adhesion and erasability . . . plus the toughness and durability of its Mylar® base. What's the latter? It's a polyester film, developed by DuPont, that's uncommonly strong and virtually indestructible . . . waterproof and almost immune to the effects of age, heat, ultraviolet exposure and handling. With our K&E "engineered surface" added, it becomes K&E Herculene Drafting Film . . . the toughest, most durable drafting medium yet to reach the drafting room. And the surface will last indefinitely, without flaking off or chipping off.

### Some Points About Paper...

K&E Albanene® Tracing Paper is the largest selling tracing paper in the world today. Why? Because Albanene is the *only* prepared tracing paper which has an "engineered surface." All other brands depend for their pencil tooth solely on the natural surface texture of the paper itself, which varies from fine to coarse . . . often on the same sheet.

Albanene invariably gives you sharp, clear pencil lines, superb reproductions. It has a solid transparentizer that is chemically stable and can't leak out, ever. This permanent transparentizing means that you'll never get white, opaque spots, even from contact with drafting tape. Try the drafting tape test yourself.

### . . . and its package

And now, all Albanene paper in rolls is packaged in the new square carton for better protection and easier storage. Your rolls stay neat and clean while in use, and the cartons will do double duty in helping you to store finished tracings. In fact, some companies are rearranging their filing systems by using Albanene cartons, which hold large numbers of rolled-up drawings and stack simply and neatly.

### Some Facts About Cloth

When you want cloth, think first of K&E Phoenix® Tracing Cloth. Besides the K&E "engineered surface" with the superb "take", adhesion and erasability for pencil, ink or typing, K&E Phoenix has all the advantages of a water-resistant, chemically-inert coating that won't soften even under high heat and won't discolor, become brittle or flake off the base. You can even clean both sides with a damp cloth, without worrying about moisture stains.

### And Some Tips On Erasing

All K&E drafting media give you excellent erasability, but there's a right way to erase on each one. On cloth and film, harsh, gritty erasers can destroy the surface. You'll get the best results with plastic erasers, such as the Richard Best "Tad" and the Eberhard Faber "Race Kleen." Moisten them for removing ink and stubborn typing; use them as they are for removing pencil lines. Large areas of ink can be removed completely without damage by using a moist cloth and Bon Ami cleanser. On Albanene, electric erasing machines are fine if used with a soft eraser.

### The Choice Is Up To You

When it comes to selecting K&E paper, cloth or film for the job at hand, we have to leave the choice to you. We're not being indecisive . . . it's just that you're the only one who knows the particular problem you have and which product solves it best. But remember . . . K&E has a *complete* line of paper, cloth and film . . . and only K&E puts a special "engineered surface" on all three media to provide a well-balanced, uniform surface suited to the base material.

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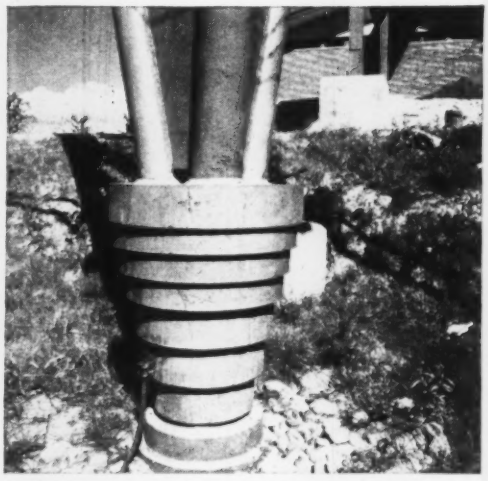
# USS cuts



**3,000,000 pounds of pressure** are concentrated at the tower base. This includes the weight of the tower and guy lines plus the downward pull of the guy lines. USS "T-1" Steel, used in the solid bar legs, carries this load.

**44% smaller legs** were possible because of the great strength of USS "T-1" Steel. Cost reduction: 15%.

# "T-1" Steel cost 15%

## in 1,199-foot TV Tower

THIS is the new 1,199-ft. WBZ-TV transmitting tower near Boston, Massachusetts. It's unique because up to the 838-ft. level its legs are of USS "T-1" Steel, a constructional alloy steel so strong it made possible significant savings for the tower owner. This structure was designed and built by Dresser-Ideco for Westinghouse Broadcasting Co.

WBZ's tower presently supports a 6-bay channel 4 antenna, but future plans call for it to carry plenty of additional weight; pending FCC approval, another 300 feet of height will bring it to an ultimate 1,499 feet. The tower had to be built with the strength to accommodate this extra weight without the necessity of future structural modifications.

Round, hot-rolled, heat-treated bars of USS "T-1" Steel were used for the three legs up to the 838-ft. height because this alloy steel has nearly three times the yield strength of structural carbon steel. It therefore enabled Dresser-Ideco to reduce the size of the legs greatly, lowering shipping weight, welding costs, wind stresses and over-all weight and price. For example, consider the leg members at the bottom of the tower. Cross-sectional area of these "T-1" bars is only 56% of the area required with the usual structural carbon steel, resulting in a 44% material savings. Also saved: the cost of hot forging and machining, since carbon bars of the size required for the biggest members are too large to be produced economically by hot-rolling. *Altogether, the builders estimate that "T-1" Steel cut the cost of this tower by 15%.*

• • •

For more information on USS "T-1" Constructional Alloy Steel, contact any office of United States Steel (listed in all phone directories), or write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. For details about the column strength of "T-1", write us for our booklet on the subject.

United States Steel Corporation, Pittsburgh
Columbia-Geneva Steel Division, San Francisco
Tennessee Coal & Iron Division, Fairfield, Ala.
United States Steel Supply Division, Steel Service Centers
United States Steel Export Company, New York

USS United States Steel

## Continuous-Girder Bridge

## Connected Across Tennessee River

**At Chattanooga, Tenn., 100-ft-long girder is lifted into position high over the waters of the Tennessee River to close steel span of the new Cedar Street bridge. Under the direction of Bethlehem Steel erection crews, the steel girder—12 ft deep and weighing 73 tons—is picked up from a barge by two 115-ton stiff-leg derricks mounted on north and south decks of the bridge. Substantial reduction in the overall steel weight (only 6,572 tons) has been achieved by use of high-strength medium-manganese steel for the continuous girder units. Structure is a continuous plate-girder span—composed of three sections of 275, 375, and 275 ft. It was designed by A. F. Hedman, M. ASCE, of Chattanooga, for the Tennessee Department of Highways.**

# N. G. Neare's * COLUMN

R. ROBINSON ROWE, M. ASCE

"A truel is cruel and the affaire unfair," quoth Joe Kerr. "Would that I knew naught of it."

"Mayhap ye do if ye say it unfair," countered Professor Neare, "but say why, or gadzooks, or something."

"My solution shows why. The relative accuracies of the truellists were given by their bulls in 80 rounds, viz, Abel : Bart : Cain :: 72 : 70 : 23. In duels between any two with a given firing order, relative success would be:

| Order | Abel | Bart | Cain |
|---|---|---|---|
| A,B | .911 | .089 | .000 |
| A,C | .969 | .000 | .031 |
| B,A | .114 | .886 | .000 |
| B,C | .000 | .961 | .039 |
| C,A | .690 | .000 | .310 |
| C,B | .000 | .684 | .316 |
| Mean | .447 | .437 | .116 |

"But for best strategy in the truel, both Bart and Cain shoot at Abel and nobody shoots at Cain, so that relative success is:

| Order | Abel | Bart | Cain |
|---|---|---|---|
| A,B,C | .627 | .064 | .309 |
| A,C,B | .627 | .071 | .302 |
| B,A,C | .315 | .402 | .283 |
| B,C,A | .056 | .640 | .304 |
| C,A,B | .448 | .321 | .231 |
| C,B,A | .056 | .709 | .235 |
| Mean | .315 | .402 | .283 |

"See what I mean, Professor? Like a battle royal, all the weaker pick on the strongest, and he's likely to lose. It's unfair."

"And I say you're wrong. Duels and truels should not reward the strongest but mark the most righteous. Even odds give the divinity a better chance of shaping their ends. Besides . . ."

"Besides," echoed Cal Klater, "Joe's wrong about Cain's best strategy. He must 'fire in turn at any target', but that target should be the ground until Abel or Bart gets his man. Then Cain has the next shot, with a chance of .310 or .316 of winning. So the truel is really two duels, first between Abel and Bart, and second between the winner and Cain, with the following chances of success: Abel, .35396; Bart, .33353; Cain, .31251. That's fairly fair."

"Exactly," agreed the Professor, "and the real problem is so much simpler, than the one Joe solved that I wont ask Cal to show us how he did it.

"For a new problem, there is a pleasanter theme and even fairer strategy, contrived by Guest Professor Sauer Doe, who will explain it to you."

"Up in the new State of Alaska," began Professor Doe, "there's a popular wayside inn called 'Buck's Quarters.' Reminiscent of that name, Buck has posted a standing offer. Order a beer and hide a buck or a quarter under your hand on the bar. If Buck guesses which coin you hid, that's what your beer costs, but if he misses, the beer is on the house. Everybody in Alaska being right smart, how much is a beer?"

*[A lot of Joe Kerrs are still scratching their heads and rubbing their eyes. Cal Klaters were Ed C. Holt Jr and Sauer Doe (Marvin A Larson), the Guest Professor.]*

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# DECEASED

**Arthur Chapman Adair** (M. '53) age 65, consultant on valuations, depreciation and depletion as related to federal taxes, died on September 4. He lived at Dunn Loring, Va. He had seen active duty in both world wars, retiring in 1946 with the rank of colonel. At one time he was valuation engineer of coal mines with the Bureau of Internal Revenue in Washington, D. C. Mr. Adair was granted a degree in civil engineering by the Virginia Polytechnic Institute.

**Robert E. Andrews** (M. '16), age 78, who retired in 1946 as assistant chief engineer with the National Board of Fire Underwriters of San Francisco, Calif., died recently. Mr. Andrews received his A.B. and his B.S. in civil engineering from the University of Michigan. A veteran of both world wars, he served in a consulting capacity on fire protection of Army and Navy establishments. He had written numerous papers on fire protection and in 1953 published a book, "Casparo Bertolotti De Salo," which was the outgrowth of a long-time interest in the history of music.

**Herman R. Blickle** (M. '10), age 88, retired vice president and consulting engineer for the Fort Pitt Bridge Works of Pittsburgh, Pa., died recently in Arlington, Va. Mr. Blickle was one of the founders of the Fort Pitt Bridge Works in 1896 shortly after his graduation from Lehigh University.

**Donald L. Chaffee** (A.M. '49), age 44, an engineer for Commonwealth Associates in Jackson, Mich., died recently in Ann Arbor. Mr. Chaffee, a graduate of Cornell University, was a specialist in electrical engineering and topography. Mr. Chaffee had been in the Wire Department of the Signal Service Agency in New Jersey; electrical engineer for the Copperwell Steel Co., Glassport, Pa.; and research engineer for the Kaiser Aluminum and Chemical Corporation.

**James H. Childs** (M. '45), age 74, former construction engineer with the U. S. Bureau of Reclamation, died in Montgomery, Ala., on October 6. Mr. Childs, who retired in 1951, had also been employed by the Reconstruction Finance Corporation, in Dallas, Tex., for which he was in charge of the construction of mine industrial plants with a total cost of $52 million. He was a civil engineering graduate of the Alabama Polytechnic Institute in 1904 and a Ph.B graduate of Yale in 1908. Mr. Childs was honored in 1951 by the U. S. Bureau of Reclamation for "commendable service" and in the same year he also received The Bronze Medal of the Department of Interior.

**William D. Crawford, Jr.** (A.M. '54), age 53, of Pittsburgh, Pa., died there recently. Mr. Crawford, who had been employed by the Duquesne Light Co., of Pittsburgh, for over fifteen years, was supervisor of structural design in charge of the design and construction of power stations. Earlier he worked in various capacities in the Engineering Department of the Borough of Ambridge, Pa., finally serving as superintendent of the Water Department. Mr. Crawford studied at Pennsylvania State University and Carnegie Institute of Technology.

**Bernard Crocker, Jr.** (M. '51), age 50, consulting engineer of Raleigh, N. C., died there on June 15. Mr. Crocker entered private practice in Raleigh after leaving the Chemical Warfare Division, which he served during World War II. In his practice he had handled over $15,000,000 worth of work in the construction and mechanical fields. After graduating from North Carolina State College, he worked with the North Carolina State Highway Department.

**Bernard Eckenrode** (M. '53), age 67, of San Diego, Calif., died there on August 30. Mr. Eckenrode, whose speciality was municipal engineering, had been employed in the San Diego City Engineer's Office since 1940, first as a senior draftsman and more recently as senior civil engineer. Previously he was bridge designer for the Washington State Highway Department and resident engineer inspector with the PWA.

**Norval Enger** (A.M. '21), age 75, retired construction engineer for the Bureau of Reclamation, died in Santa Rosa, Calif., on September 25. An engineer for the Bureau for 27 years, he retired in 1953 after the completion of the Angostura Dam project at Hot Springs, S. Dak. Mr. Enger was a civil engineering graduate of the University of Illinois.

**Erik Floor** (M. '46), age 67, founder and president of Erik Floor & Associates, Inc., of Chicago, died there on July 31. Mr. Floor, an electrical engineering graduate of the University of Copenhagen, was employed with A. G. Siemens-Schubert and the Danish State Railway before coming to the United States. As a specialist in hydroelectric generation, he was associated with the Harza Engineering Co., first as chief electrical engineer, and, later as vice president and chief engineer. He formed his own company in 1945.

**Robert Gordon Frank** (A.M. '42), age 49, construction management engineer for the Corps of Engineers at Porterville, Calif.; died August 14. Mr. Frank began his engineering career in 1929 with the Kansas Highway Commission. From 1941 to 1945 he served the War Department as a civilian engineer. More recently he had been with the U. S. Bureau of Reclamation in Wyoming.

**Robert M. Fraser** (M. '17), age 75, retired plant engineer with the Rome Cable Corp., of Rome, N. Y., died on October 2. Mr. Fraser, who had recently announced his retirement, had been associated as general plant engineer with the General Cable Corporation of White Plains, N. Y., for many years.

**Ralph E. Glasheen** (A.M. '48), age 61, of Wyncote, Pa., died in Elkins Park, Pa., on August 5. He was architects' representative for Thalheimer & Weitz, of Philadelphia. Earlier he was with the Philadelphia Transit Company, as superintendent of the Buildings Division.

**Lester Gurney** (A.M. '17), age 70, consulting construction engineer of Bristol, R. I., died in August. For a quarter of a century Mr. Gurney was connected with the New England Power Company, which he served as assistant engineer, resident engineer, and construction manager. He entered private practice in 1954.

**Arthur S. Hatch** (M. '43), age 66, engineer in charge of the Reservoir Land Section of the City of Houston, Tex., died on September 26. Mr. Hatch began his service with the City of Houston in the early 1930's as an inspector and construction engineer with the Water Department. In 1941 he was engineer in charge of the city-sponsored WPA-PWA construction programs. Mr. Hatch received his A.B. in engineering from Harvard University and did postgraduate work at Massachusetts Institute of Technology.

**Charles E. Huber** (A.M. '40), age 72, retired structural engineer for the Kilroy Structural Steel Company, of Cleveland, Ohio, died in Toledo, on August 27. He was a civil engineering graduate of Ohio Northern University. A specialist in the design of steel and concrete bridges and buildings, Mr. Huber had been a designer for the Cleveland Union Terminal Company and the Austin Company, both of Cleveland. During World War II, he served as associate engineer in the U. S. Engineer Office attached to the War Department.

**Ernest Kitchen** (M. '25), age 70, of St. Petersburg, Fla., died there on August 21. In his early career Mr. Kitchen had been city engineer and director of public works for St. Petersburg. He had also been chief engineer and vice-president of the H. C. Nutting Co., Cincinnati. Of more recent years he was assistant regional director of Defense Public Works in Washington, D. C. Mr. Kitchen was a veteran of World War I, in which he served as a captain.

**Marshall O. Leighton** (M. '11), age 84, consulting engineer of Washington, D. C., and a resident of South Portland, Me., died on August 29. Mr. Leighton was for many years a partner in the firm of Leighton and Gamble of Washington, D. C. After graduating with a B.S. from Massachusetts Institute of Technology, he specialized in hydrography, water power, and drainage. Mr. Leighton was author of many papers on engineering.

**T. D. MacNeil** (M. '28), age 86, of Mount Vernon, Wash., died there on Sep-

*(Continued on page 114)*

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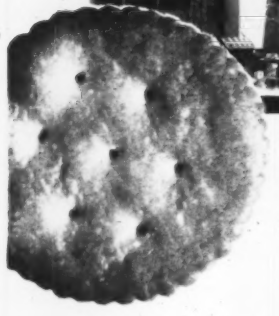

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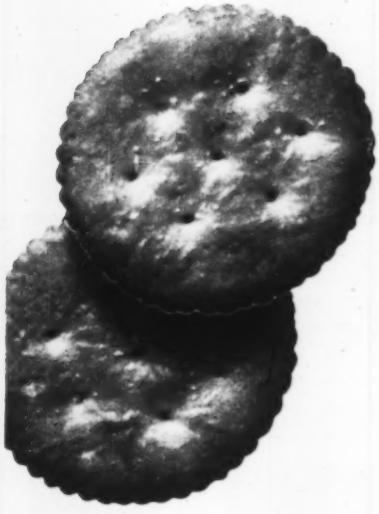

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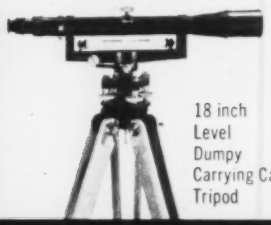

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## Non—ASCE Meetings

**American Institute of Electrical Engineers.** Winter general meeting, at the Statler and Sheraton-McAlpin Hotels, New York City, February 1-6. Further information available from Raymond C. Mayer & Associates, 36 W. 46th St., New York 36, N. Y.

**American Institute of Mining Engineers.** Annual meeting at the St. Francis, Sheraton-Palace and Sir Frances Drake Hotels, San Francisco, Calif., February 15-19. For information write AIME, 29 W. 39th St., New York 18, N. Y.

**American Road Builders Association.** Fifty-seventh annual meeting at the Adolphus Hotel, Dallas, Tex., January 19-22. Inquiries to the ARBA, World Center Building, Washington 6, D. C.

**American Society of Heating and Air-Conditioning Engineers.** Sixty-fifth annual meeting at the Bellevue-Stratford Hotel, in Philadelphia, Pa., January 26-29. For further details write ASHAE, 62 Worth St., New York 13, N. Y.

**American Society for Testing Materials.** Committee Week at the Penn-Sheraton Hotel, Pittsburgh, Pa., February 2-6. Information available from the Society, 1916 Race St., Philadelphia 3, Pa.

**Associated General Contractors of America.** Fortieth annual convention at the Americana Hotel, Bal Harbour, Miami Beach, Fla., January 19-22. For information write the Associated General Contractors, 20th and E Streets, N.W., Washington 6, D. C.

**Building Research Institute.** Noise Control Conference at the New Yorker Hotel, New York City, January 14-15. For information write Harold Horowitz, BRI Technical Secretary, 2101 Constitution Ave., Washington 25, D. C.

**Highway Research Board.** Thirty-eighth annual meeting at the Sheraton-Park Hotel, Washington, D. C., January 5-9. Additional information is available from Fred Burggraf, Director, Highway Research Board, 2101 Constitution Ave., Washington 25, D. C.

**Institute of Transportation and Traffic Engineering of the University of California.** Eleventh California street and highway conference at Berkeley, January 28-30. Information from the ITTE, University of California, Berkeley, Calif.

**Texas Society of Professional Engineers.** Annual convention at the Shamrock Hilton Hotel, Houston, Tex., January 22-24. For information write San Jacinto Chapter, Texas Society of Professional Engineers, Houston, Tex.

# Weldynamics

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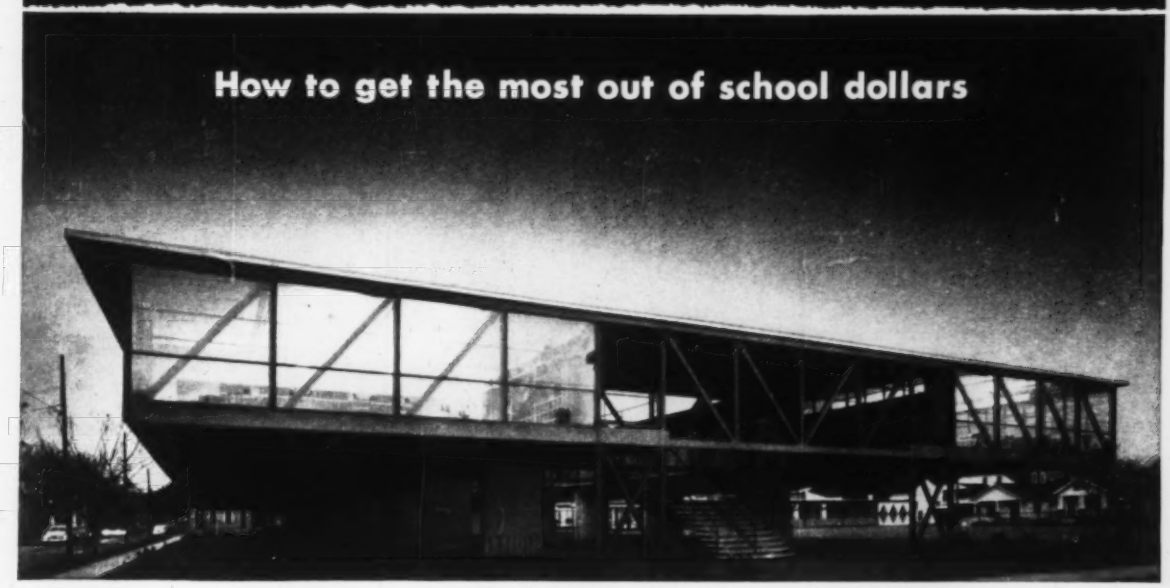


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(*Continued from page 110*)
tember 18. Mr. MacNeil had been a general contractor in Washington since 1928. Earlier he was deputy county engineer for Skagit County and resident engineer on the Riverside Pacific Highway for the state of Washington.

**John M. Schaser** (A.M. '58), age 42, hydraulic engineer for the U. S. Bureau of Reclamation at Sacramento, Calif., died on September 9. A civil engineer in federal employment for over twenty years, Mr. Schaser had just received a special award from the Commissioner of Reclamation for his outstanding work in making studies pertaining to water rights along the Sacramento River and in the Sacramento-San Joaquin delta in California. Mr. Schaser had worked for the Bureau all over the West. He was a graduate of the University of Denver.

**William O. Weathersby** (M. '44), age 61, engineer for the American Bridge Co., of Pittsburgh, Pa., died on August 21. Mr. Weathersby had been field engineer on construction of the Ohio River Bridge at Ambridge, Pa.; the Allegheny River Bridge at New Kensington, Pa.; and viaduct approaches to the Cleveland Union Terminal and the Ohio River Bridge at Louisville, Ky. He had also worked on a Mississippi River Bridge in Louisiana.

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**Chamber's Technical Dictionary.**

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A new edition of a standard reference work encompassing the fields of science, engineering and manufacturing. New terms have been added, while older terms have been revised where necessary to include new aspects. (Edited by C. F. Tweney and L. E. C. Hughes. Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1958. 1028 pp., bound, $7.50.)

**Elsevier's Dictionary of Nuclear Science and Technology.**

Contains over 4,000 words which are defined in English, with a clear distinction between American and British usage. Each word is defined according to the most precise international standard available. Corresponding terms are then given in French, Spanish, Italian, Dutch and German arranged horizontally across the facing page. An alphabetical list at the conclusion of the book provides a cross reference from the terms in the non-English languages to the English equivalent. (Compiled by W. E. Clason, D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J., 1958. 914 pp., bound, $25.00.)

**Entwurf und Berechnung Von Stahlbauten.**

Volume 1: Grundlagen des Stahlbaues.

This first volume of a series on the design and calculation of steel structures covers the following: steel as a building material; riveted, bolted, and welded connections; numerical solutions in statistics; bending and torsion of beams; stability problems—buckling and collapsing; vibration; and the determination of optimum dimensions and characteristics of structural elements. (By Fritz Stüssi. Springer-Verlag, Berlin, Germany, 1958. 577 pp., bound, 55.50 DM.)

**Environmental Sanitation.**

Emphasis is placed on planning for the small community of less than 5,000 persons. Among those aspects given consideration are control of communicable disease; location and planning in relation to sites for camp, industrial, housing, and similar uses; water supply sources, construction, treatment, and distribution; waste-water treatment and disposal; swimming pools and bathing beaches; food; insect, rodent, and noxious weed control; hygiene of housing. Empirical formulas and rules of thumb are applied when they are advantageous. (By Joseph A. Salvato, Jr. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1958. 660 pp., bound, $12.00.)

**The Shippingport Pressurized Water Reactor.**

All aspects of the design and construction of the Shippingport reactor are discussed. Among the topics included are the factors entering into the selection of plant design parameters; reactor design, fuel element development, and core construction; radioactive waste disposal system; electrical and mechanical components used in the reactor plant; shieldings of the reactor plant and waste disposal facilities; hazards evaluation; a description of the turbine-generator plant; training of personnel. A volume in the Atoms for Peace presentation set. (By the U. S. Atomic Energy Comm., Division of Reactor Development, Naval Reactors Branch. Addison-Wesley Publishing Co., Reading, Mass., 1958. 588 pp., bound, $9.50.)

**Technical Drawing.**

Fourth Edition

A thorough revision of a well known text. Areas which have been given particular attention in this edition include geometrical constructions; dimensioning and notes; threads, fasteners, and springs; shop processes; engineering graphics; structural drawing; topographic drawing; weld-

(*Continued on page 120*)

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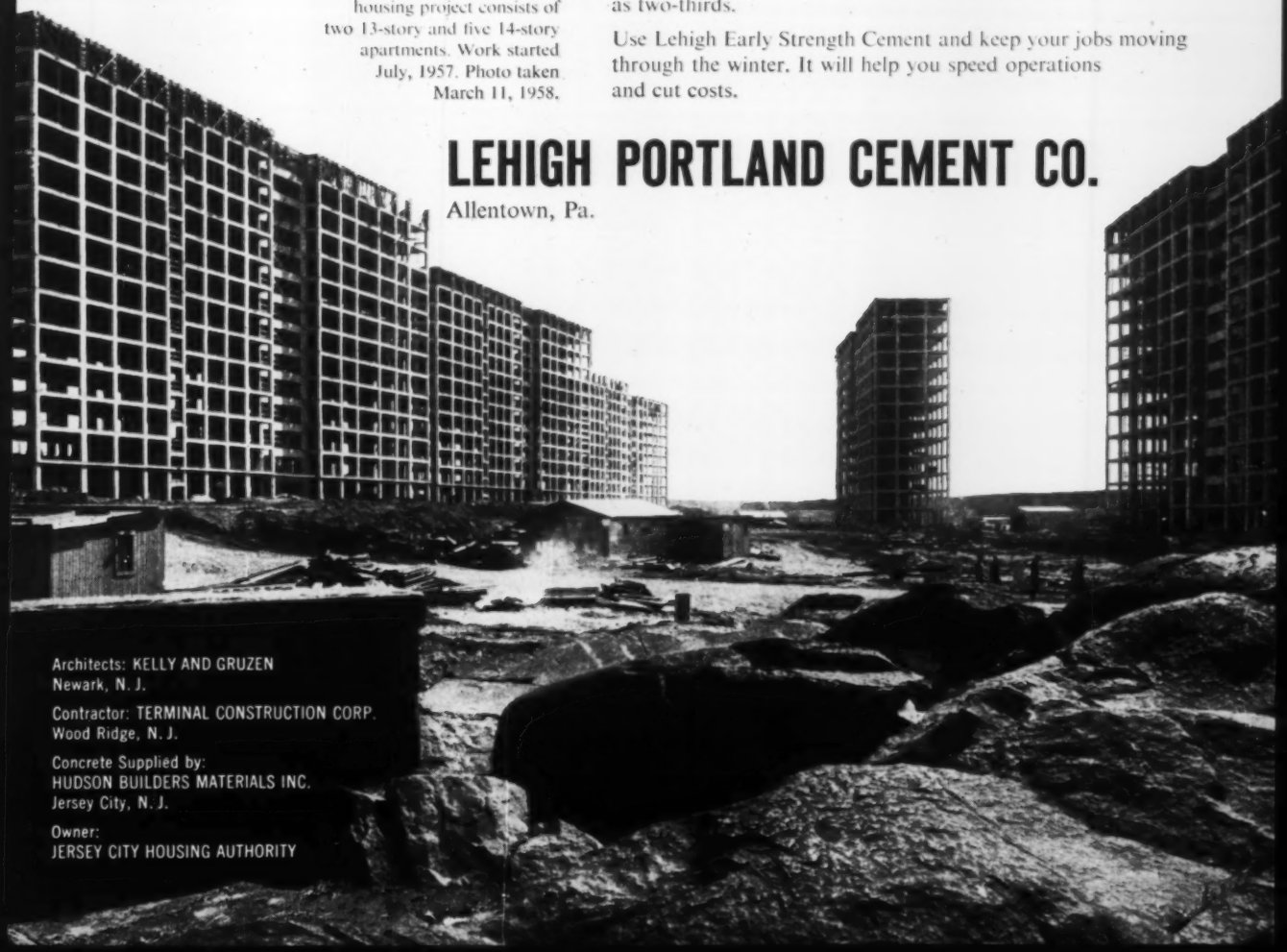

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VICTORIO BLAS GALLO, Harrisburg, Pa.
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ANDRIES PETRUS CORNELES OOSTHUIZEN, Johannesburg, South Africa
JOHN GEORGE POEHLING, Omaha, Neb.
THEODORE MARTIN PORTER, Fresno, Calif.
ARTHUR PRICE, Woodridge, N. J.
JINDAL ROOPLALL, Urbana, Ill.
JOSEPH STANLEY SHULTZ, Prairie Village Kans.
MAURICIO CHEBRAUI STADE, El Salvador, C. A.
MOSTAFA MOHAMED SOLIMAN, Logan, Utah
IVAN EDWARD SVENSON, Richmond, Calif.
ANTONIO TINOCO NETTO, Rio de Janeiro, Brazil
LUIS UGUETO ARISMENDI, Caracas, Venezuela
ARIE VAN DER LAAN, New York, N. Y.
JAMES HARLAND WOODSTROM, San Bernardino, Calif.

*[Applications for Junior Members from ASCE Student Chapters are not listed.]*

*Fast-Driving, Versatile*

**VULCAN**
**DGH-100**
**PILE HAMMER**
***speeds work on sewer project***

The Vulcan DGH-100 Portable, Differential-Acting Hammer is driving 3" x 8" x 24' timbers to a depth of 20 feet to form bins 8' wide and 24' long used in the construction of a sewer line in Edina, a suburb of Minneapolis. Contractor: Phelps-Drake Co., Minneapolis. The Vulcan DGH-100 is a favorite with contractors everywhere.

*Ask for full information*

*Manufacturers of Pile Driving Hammers and Piling Extractors Since 1852*

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## Positions Announced

**San Francisco Bay Area Rapid Transit District.** Vacancy for the new position of Chief Engineer on district staff. Duties will include full charge of engineering activities for district. Salary range: $20,000-30,000 yearly. Applicants must be recognized and experienced in the profession and must have proficiency in cost analysis and estimating. Applicants should write to General Manager J. M. Peirce, 628 Flood Building, San Francisco 2, Calif.

The Mathews barrel, containing all working parts of the hydrant, is readily removed for inspection or repair by simply unscrewing it from the elbow and withdrawing it through the protection case.

# I want you to see for yourself how the Mathews replaceable barrel is a real community asset

I can show you easily and quickly with this scale model. See? When a Mathews is broken by a skidding automobile, you can slip in a new barrel in a matter of minutes, *and without excavating.* It's a real safety feature for the community—allows only momentary interruption of neighborhood fire protection.

And these additional quality features help keep the Mathews at the head of the line:

- Compression-type valve opens against water pressure—a positive leakproof construction
- Operating thread cannot be bent
- Head revolves 360° just by loosening bolts
- Nozzle sections are changeable
- Nozzle levels can be raised or lowered without excavating
- Bell, mechanical-joint or flange-type connections
- O-Ring seal furnished when specified

MATHEWS HYDRANTS—by **R. D. WOOD COMPANY**

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

# ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

## Men Available

CIVIL ENGINEERING, J.M. ASCE, 28, B.C.E., four years in construction, including highways and foundations; two years in design and analysis of steel and concrete structures; desires position where development of a structure begins from a sketch. Will relocate in U.S. or Overseas. C-397.

INDUSTRIAL WASTES ENGINEER, A.M. ASCE, Ph.D., 30. Eight years' diversified experience in research, development, plant operation and consulting; seeking affiliation with research or engineering department of chemical process or allied industry in pollution abatement capacity, management potential. C-398.

PROJECT MANAGER, M. ASCE, B.S.C.E., 49. Resident engineer, domestic and overseas, from 1931 to 1945. Project manager on construction, domestic and foreign from 1945 to 1955. Engineering consultant and project manager from 1955 to 1958. Location desired: East, South, or foreign. C-399.

CIVIL ENGINEER, J.M. ASCE, B.C.E., (Cooperative) 20 months with railroad plus 18 months as cooperative student. Balanced experience including both office design and field layout of industrial sites, trackage, drainage structures, and new alignment including construction surveys. California EIT Certificate. Presently in Military Service. Available mid-April, 1959. Location desired, South. C-400.

DESIGN ENGINEER, M. ASCE, D.Sc., licensed P.E. New York State, 54; presently employed as structural engineer, having wide European experience in laboratory, research and construction, including prestressed concrete. Seeks position in research and development. C-401.

CIVIL ENGINEER, J.M. ASCE, B.S.C.E., 45. Five and one half years' design reinforced concrete, foundations, reports writing; 1½ years' surveying and road maintenance. Present position is in responsible charge of all civil engineering for construction department. Concentration on investigation, concept, and design of static and dynamic foundations; supervision of related field and office activity; material and construction specifications writing. Location desired: West or South. C-402-191-San Francisco.

CIVIL ENGINEER OR PLANT ENGINEER, J.M. ASCE, B.S.C.E., M.S.C.E., 32. Four years' structural, heating and ventilating, and air conditioning design and supervision in commercial and industrial construction. P.E. license in Ohio and Indiana. Desires a position of greater responsibility with a small or medium size manufacturing organization's engineering department. Locations desired: Midwest, South, Northern New England, Western New York, Western Pennsylvania. C-403.

DESIGN ENGINEER, A.M. ASCE, B.S.C.E., M.C.E., 56. Registered P.E. in New York and New Jersey. Last seven years as chief civil engineer with major chemical company on estimates, project evaluation, specifications and designs of site development, foundations, structures and plant utilities. C-404.

RESIDENT ENGINEER, A.M. ASCE, B.S.C.E., M.I.T. graduate, 40. Fourteen years' experience civil engineering, steelworks, hydroelectric, oil refineries, sanitary and structural, capable both design and field work; nine years overseas. Desires position as resident engineer, chief engineer

(*Continued on page 119*)

THE MINNESOTA HIGHWAY DEPARTMENT

SEEKS A TOP-LEVEL

***Highway Engineer***

To direct a major division developing the long-range state highway program.

$10,956 to $13,344

- Use the most modern engineering and programming equipment in a new highway building.
- Locate in a progressive metropolitan center with a wide variety of cultural activities with nearby "vacationlands" for the outdoorsman.
- Fringe Benefits are liberal.

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**CIVIL ENGINEERS**

Vacancy due to a new position in Madison, Wis. Graduate engineer with some experience to begin in Engineering Dept. when available. Beginning salary January 1, 1959 is $506 a month **unless** special arrangements for a higher entrance salary due to qualifications. Annual and longevity increases to $635. Office and field work in design and construction of sewer, water, street, sidewalk and curbs. Possession of EIT certificate required. No residence restriction for U. S. citizen to begin work. Two weeks vacation, three weeks after ten years; 5-day week; sick leave. Wis. Retirement Fund and Social Security benefits.

**Personnel Department**
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**Madison 9, Wisconsin**

## RESEARCH ENGINEERS

The Engineering Mechanics Department of Southwest Research Institute has a limited number of attractive positions for well qualified personnel. These positions offer an outstanding opportunity for challenging work in structural mechanics, theoretical and applied mechanics, and experimental stress analysis. A wide range of assignments on programs related to missiles, ships, submarines, space vehicles, nuclear power, pressure vessels, offshore drilling systems, and weapons effects accelerate the rate of professional progress.

Candidates should have an M.S. or Ph.D. Degree with research experience being desirable.

Please send resume and salary requirements to:

**Mr. R. C. Mays, *Personnel Director***

**Southwest Research Institute**
**8500 Culebra Road**
**San Antonio, Texas**



## RESEARCH ENGINEER

Civil engineer with sanitary engineering training or a chemical engineer. Large Midwestern city. Good opportunity for young man with up to four years of experience. Position open requiring sound technical background, flexibility and imagination. Will start in a small department with a wide variety of problems in sanitary engineering. Starting salary commensurate with training experience.

**Box 291**

**Civil Engineering**
**33 West 39th Street**
**New York 18, New York**


## ESPS

*(Continued from page 118)*

or equivalent on suitable overseas project. Fluent French. C-405.

CIVIL ENGINEER, J.M. ASCE, B.S.C.E., 26. Two years' steel and concrete design of structures for industrial installations and water works. One year experience in general administration with foreign organization. Presently pursuing degree in management engineering. Desires position in this field. Location preferred, New York City, but will relocate if graduate school available. C-406.

CIVIL ENGINEER, J.M. ASCE, M.S.M.E., 30. Project engineer and superintendent of heavy construction, four years. Extensive experience with foundations and concrete. Field Engineer, chemical plants, three years. Desires supervisory or managerial position. C-407.

PLANT ENGINEER, A.M. ASCE, B.S.C.E., 37. Three and one half years as structural engineer designing industrial plants; three years as job superintendent on institutional and industrial type buildings; two and one half years as assistant job superintendent. Location desired: Midwest. C-408-912-Chicago.

CIVIL ENGINEER, J.M. ASCE, B.C.E., 25. One and one half years of diversified civil experience on design and construction of hydraulic, waste and structural works. Fifteen months of experience on industrial work planning, programming and scheduling. Location desired: South or overseas. C-409-910-Chicago.

## Positions Available

ENGINEERS. (a) Sanitary Engineer, experienced in the design of sewage treatment works; would also be required to work on water treatment plants and other projects in the water and sewerage fields. Salary open. Location, upstate New York. (b) Engineer's Assistant for the layout and inspection of sewer construction. Salary open. Location, vicinity of Poughkeepsie, New York. W-4747.

TEACHING PERSONNEL in engineering, mathematics, physics and chemistry. Program of development includes strengthening faculty, inaugurating a graduate program and designing a new science and engineering building. Location, Middle East. F-6237.

CIVIL ENGINEERS, either a recent graduate or with less than five years' experience to do both office and field work in a consulting-firm. Good salary, excellent opportunity. Location, upstate New York. W-6557.

VICE PRESIDENT, civil or structural engineer, registered, with sales or contract experience, for structural steel fabricator. Should be qualified in structural design, proposals, contracts and client contact. Salary, $15,000-$25,000 a year, commensurate with qualifications and experience. Location, Pittsburgh, Pennsylvania area. W-6568.

SENIOR HYDRAULIC ENGINEER, graduate civil, with two years experience in hydraulic engineering, and an interest in surface water resources development, flood control, reservoir and dam design and/or open channel hydraulics. Salary, $5700-$6900 a year. Must be resident of New Jersey as position is located that state. W-6569.

SENIOR SANITARY ENGINEER, P.E. license desirable but not necessary. Must be capable of handling design of sewerage systems and treatment plants and have knowledge of water systems. Must have ability to handle men as this position will shortly lead to supervisory position. Salary, $7800-$8320 a year. Opportunity for overtime and fringe benefits. Company will pay placement fee. Location, Connecticut. W-6613.

ASSOCIATE PROFESSOR OR PROFESSOR, Doctorate required, for research and teaching in structures. Salary, $8400-$9600 a year. Location, South. W-6616.

PUBLIC HEALTH ENGINEER OR SANITARY ENGINEER, or other related academic background and experience; advanced degree desirable. Responsibilities will include coordination of existing programs in sanitation, waste handling, inspection procedures, etc. and organization and planning of future programs. Also, some instruction in proper

*(Continued on page 120)*


# ENGINEERS

**PERMANENT OPENINGS FOR QUALIFIED MEN EXPERIENCED IN THE DESIGN OR SPECIFICATIONS FOR**

# AIRPORTS
# BRIDGES
# BUILDINGS
# HIGHWAYS
# RAILROADS

PREFER GRADUATE REGISTERED ENGINEERS WHO SEEK LONG RANGE EMPLOYMENT WITH AMPLE OPPORTUNITY FOR PROFESSIONAL DEVELOPMENT AND ADVANCEMENT IN A STEADILY EXPANDING AND GROWING ORGANIZATION.

Paid vacation, sick leave, holiday, overtime. Excellent Employee Benefits Plan provides retirement income plus life and disability insurance. Blue Cross. Moving allowance.

Work will be in the general offices in St. Louis. Interviews can be arranged in Washington, D. C., and San Francisco also.

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*Please write fully, including salary data, to*

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*ENGINEERS — ARCHITECTS*
915 OLIVE • ST. LOUIS 1, MO.

## ESPS

(*Continued from page 119*)

sanitation practices to employees and students. Location, Pennsylvania. W-6630.

SALES ENGINEER, Sanitary, to sell industrial and municipal waste disposal equipment; preferably a Master's degree in sanitary engineering, and work experience on a state board of health, in industry, apply sanitary engineering background or in municipal work. Will consider recent graduate sanitary engineer with sales potential. Salary open depending upon experience and educational background. Location, Philadelphia, Pennsylvania. W-6641.

JUNIOR ENGINEERS. (*a*) Civil graduate, preferably single. Should have three to four years' experience covering at least two or three of the following areas: surveying and topographical mapping, structural design and construction, hydraulic engineering, irrigation and drainage, and pump installation. Salary, $6000-$7200 a year. (*b*) Recent civil graduate, preferably single, for work as outlined above. Salary, $4800-$5400 a year. Location, Honduras. F-6678.

DIRECTOR OF ENGINEERING AND CONSTRUCTION, graduate, for a large food and beverage company. Will take complete charge of actual construction on new plant, as well as engineering and maintenance when in operation. Salary, $25,000-$30,000 a year. Location, Midwest. W-6700.

TEACHING PERSONNEL. (*a*) Assistant Professor in civil engineering, to teach theory of structures, materials of construction, and steel and timber structures. (*b*) Assistant professor in civil engineering, to teach soil mechanics, foundations and reinforced concrete. Salaries, $4800-$6000 a year. (*c*) Professor of civil or mechanical engineering, to teach 3rd and 4th year engineering and to serve as Dean of College. Salary, $7200-$8400 a year. Transportation will be paid for applicant and wife. All salaries are tax exempt. Locations, Foreign. F-6683.

FIELD OFFICE AND COST ENGINEER for construction company specializing in industrial buildings. Must have knowledge of costs and estimates in general construction and be willing to reside where jobs are located. Two openings at present; one in northern New Jersey, the other in Cincinnati, Ohio. Salary, $8400-$9600 a year. W-6701.

SALES ENGINEER with engineering training and asphalt highway experience, for sales promotion and application work covering asphalt sealing compounds. Considerable traveling in U.S.A. except Pacific Coast. Salary, $7500 a year, plus bonus. Headquarters, New York, N.Y. W-6702.

STRUCTURAL ENGINEER. Masters or Ph.D. degree, with considerable experience, for a prominent consulting engineering firm. Location, Midwest. W-6726.

PROJECT ENGINEER, graduate civil, to take complete charge of preliminary sewerage surveys for large municipality in South America. Would prepare master plan for all sanitary facilities. Knowledge of Spanish desirable. Salary open. One year to 18 months work. Location, South America. F-6722.

TRAINEES, graduate mechanical or civil, for multi-plant operation for the manufacture of cement, lime, refractory and related products. Salary, about $6000 a year. Location, Midwest. W-6729.

CIVIL ENGINEER, concrete pipe, to supervise concrete pipe and development department. Experience must include pipe design, stress analysis and group leader experience. Will also supervise culvert and pressure vessel design; mixed design; laboratory and development work. Salary open. Location, southern California. S-3896.

(*Continued from page 114*)

ing representation. The majority of the illustrations have been redrawn, and the format of the book has been enlarged to permit clearer illustrations. The entire volume has been revised to reflect the latest American Standards. (By Frederick E. Giesecke and others. Macmillan Company, 417 Fifth Avenue, New York 16, N. Y. 844 pp., bound, $10.00.)

### Sodium Graphite Reactors.

Placing emphasis on the Sodium Reactor Experiment (SRE), such aspects are covered as the reactor and its shielding, cooling, and fuel-handling systems; nuclear, heat-transfer, and transient characteristics; design and development of components; installation of equipment and operation of the plant. In addition information of a general nature is included dealing with the origin of the sodium graphite concept, the technologies of sodium, graphite, and zirconium as they relate to sodium graphite reactor design, and fuel element development. A volume in the Atoms for Peace presentation set. (By Chauncey Starr and Robert W. Dickinson. Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958. 288 pp., bound, $6.50.)

### Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.


# STRUCTURES RESEARCH

Outstanding opportunities exist in the Structures Section for young creative and imaginative engineers. These positions offer an opportunity to work in small project groups in an intimate environment with some of the leading engineers in this field. We need men who are interested or have experience on research problems in:

STRUCTURAL DYNAMICS ELASTICITY
PLASTICITY THERMOELASTICITY
MINIMUM WEIGHT DESIGN
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These positions are non-routine and require men with initiative and resourcefulness. Degree in Mechanical Engineering, Civil Engineering or Mechanics required.

Excellent employee benefits including tuition free graduate study and a liberal vacation policy.

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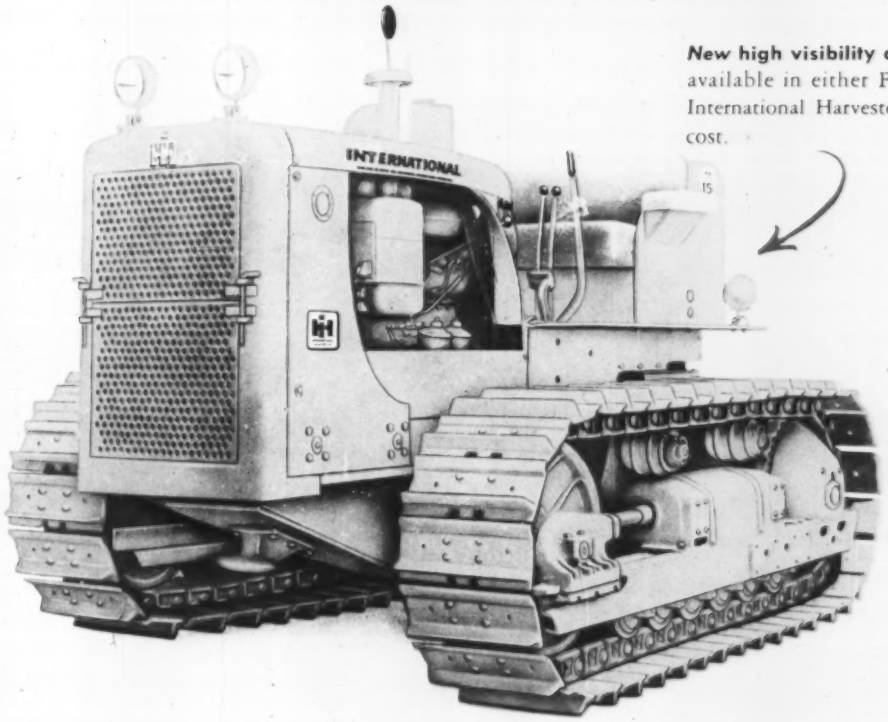
# THE TREND
IN DRAFTING ROOMS
THROUGHOUT
THE WORLD IS
TOWARD **IMPERIAL,**
THE WORLD'S FINEST
# TRACING CLOTH

# NEW International® TD-15 tops 100-hp field...

## *with exclusive power and control features!*




***New* high visibility color.** Optionally available in either Federal yellow or International Harvester red at no extra cost.

NEW

**6-cylinder diesel power** . . . 105-hp fully-proven D-554 engine—full 20,500 lbs drawbar pull.

NEW

**6-speed full-reverse transmission** . . . 20% higher reverse speeds. A speed for every work or travel need plus fast "Shuttle-Bar" direction changing!

NEW

**Precision control**

Foot Decelerator for instant speed changes—fast "Shuttle-Bar" forward-reverse travel.

NEW

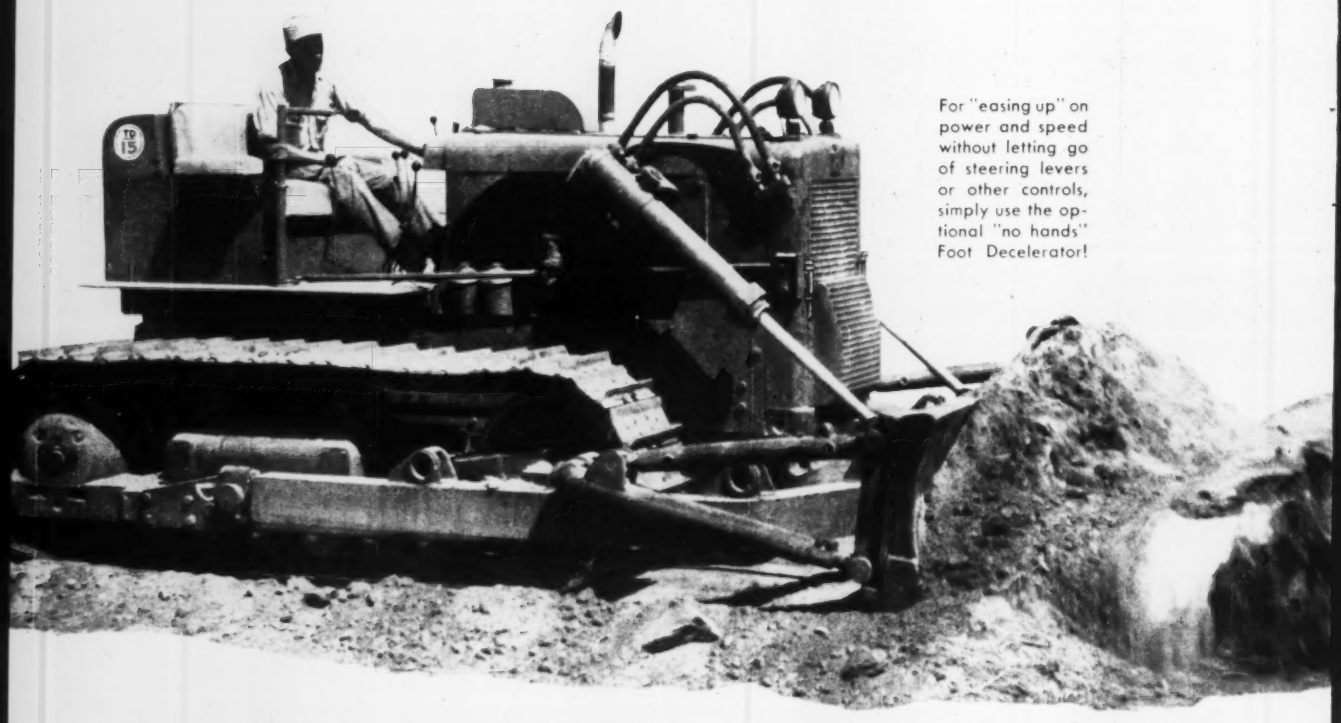
**1,000-hour lube interval, heavy-duty track rollers**

. . . heavy-duty, long-life bushing type, with extra capacity lube reservoir.

***...and here's the pay-off for you...***

# *You move in on...and speed up*

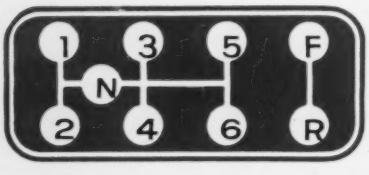
# ....with NEW TD-15



For "easing up" on power and speed without letting go of steering levers or other controls, simply use the optional "no hands" Foot Decelerator!

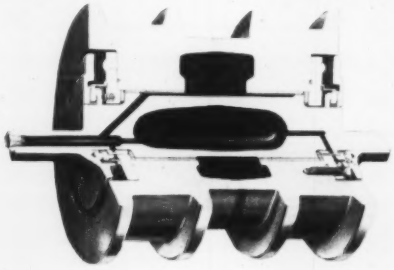
## Exclusive six-speed "single stick" shift... forward and reverse "Shuttle-Bar"

You shift through all six speed ranges of the new TD-15—forward or reverse—with a single lever. Shift pattern is planned for gear-changing ease and speed with a fast sweep of the hand—to give you instant use of the speed you need. To speed the work-cycle and take full advantage of fast shifting, you simply push or pull the "Shuttle-Bar"—to change TD-15 forward or reverse instantly.




## 1,000-hour lube interval, heavy-duty, track rollers

Not just another "claim" . . . International now combines heavy-duty *bushing design*, exclusive cartridge-type *metal-to-metal seals*, and king-size lube reservoirs, to offer the industry the first heavy-duty type roller as standard equipment on the TD-15. Thick shells for safe build-up and exclusive pressure relief passages for flush-out and prevention of seal damage from power lubricators are part of this new design.



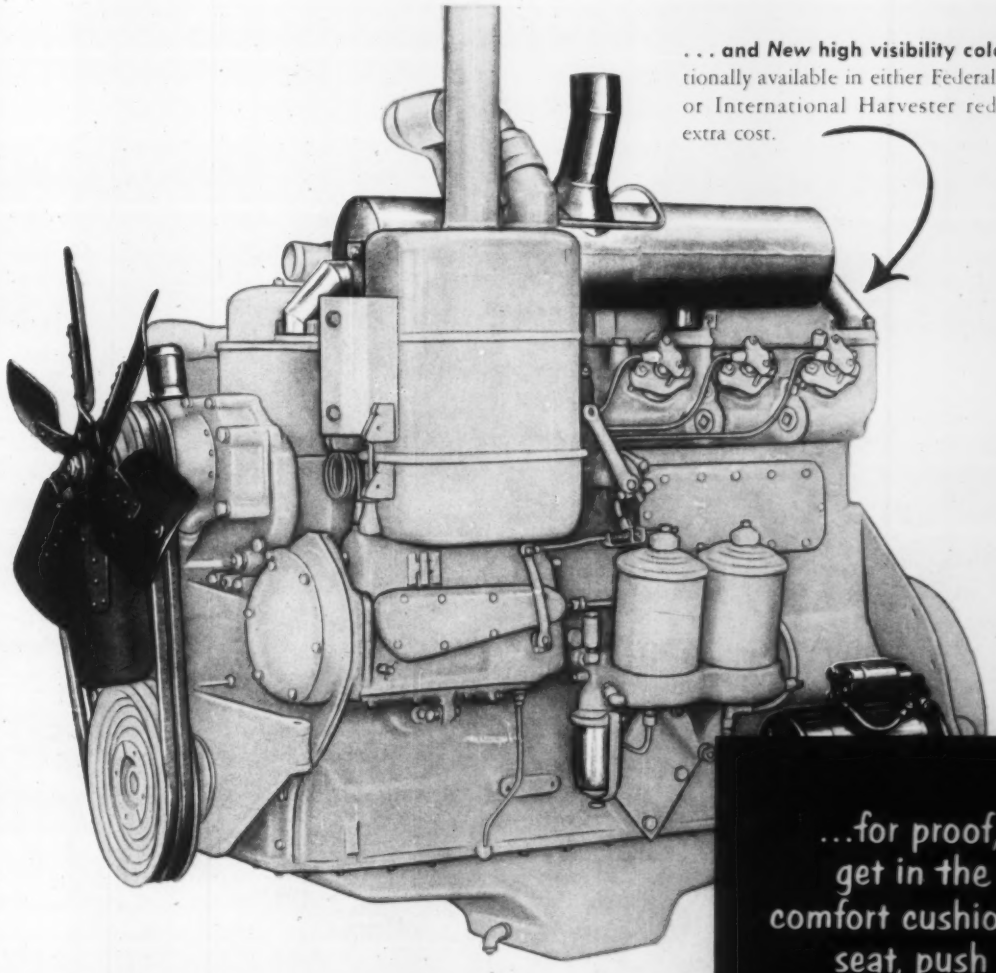
# ...a whole new range of jobs...

# capacity and control

## Smooth 6-cylinder... BIG 105 IH diesel horsepower

You get 6-cylinder smoothness from this new International D-554 diesel engine that powers the new TD-15. This fully-proven power plant produces its 105 net hp at 1,650 rpm . . . features famous International 45-degree angle operation full-flow lubrication, closed pressurized cooling, exclusive twin plunger pump fuel injection system, fully counter-balanced crankshaft, positive valve rotators, and all-weather gasoline conversion starting. Here's an engine built for long life, big-capacity output!

**New power, strength, control, and reliability** features like these show you how and why the 105-hp TD-15 tops its field. You move in on a new range of heavy jobs—material-moving, land-clearing, hauling, loading, excavating, logging, mining—that no longer belongs to next-size-bigger crawlers!



**. . . and *New* high visibility color.** Optionally available in either Federal yellow or International Harvester red at no extra cost.

...for proof, get in the comfort cushioned seat, push the "button"...

# Compare TD-15 performance to anything *in the 100 hp crawler field!*

Prove to yourself you can move in on, and speed up, a whole new range of heavy jobs—with new TD-15 capacity and control. Put the TD-15 through its paces—compare *power*, *speed*, *capacity*, and *control* to anything else on tracks in the 100 hp field. The 6-speed full-reverse transmission and "Shuttle-Bar" will show you on-the-job how fast, easy, and profitable shuttle-cycle operations can be! Press the decelerator and see what a helper this feature can be for actually speeding up operations—by reducing declutching and shifting time! Measure sintered metal, dry-type clutch full power transfer efficiency and maintenance, ease and economy to any other crawler's clutch—wet or dry! See your International Construction Equipment Distributor for a new TD-15 demonstration!

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers and Bottom Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

# AMERICA'S *FIRST* COMPLETE SERVICE TO THE SEWAGE TREATMENT INDUSTRY—

## *Smith & Loveless* FACTORY-BUILT LIFT STATIONS AND SEWAGE TREATMENT PLANTS

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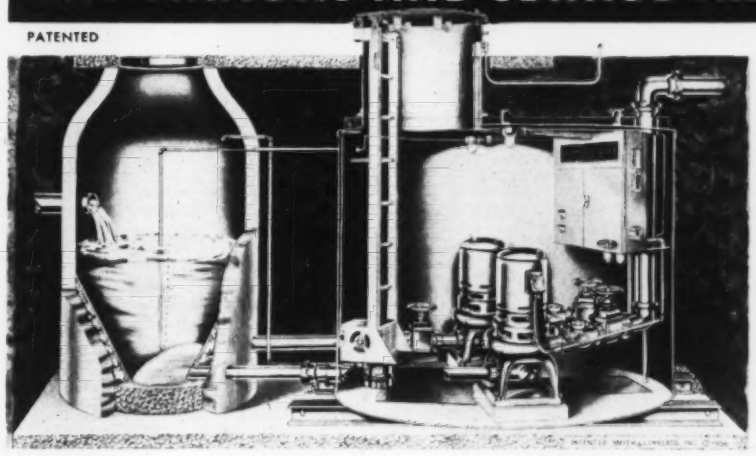
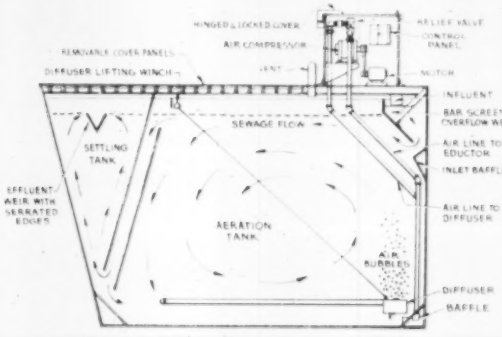


### AMERICA'S FINEST FACTORY-BUILT DUPLEX SEWAGE PUMP STATION

Today's finest pump station. Built from the most advanced design, by skilled factory-trained personnel, using quality materials and equipment.

Precision assembled, central electrical control cabinet prewired and color coded, dehumidified interior to prevent condensation. Pumps have pressurized mechanical seals. Low in initial cost and easy to install. Smith & Loveless stations are designed to provide maximum efficiency and long life with a minimum of maintenance.

Smith & Loveless offer a complete line of standard size factory-built lift stations with capacities up to 4500 G.P.M.




### *Smith & Loveless* "OXIGEST" SEWAGE TREATMENT PLANT

A high-quality, low-cost sewage treatment plant for sub-divisions, schools, motels and industrial plants. The "Oxigest" plant has been carefully engineered for dependable treatment without requiring the services of a skilled operator. Approved by F.H.A. and State Health Departments where submitted.

Built of the finest materials and properly reinforced to withstand interior and exterior pressures. The Smith & Loveless "Oxigest" will provide a permanent plant with minimum annual maintenance. Smith & Loveless also provide a complete line of "Sy-No-Seal" rotary distributors and other sewage treatment equipment.

*Write for Smith & Loveless "Oxigest" data manual with design notes, specifications, drawings, etc.*

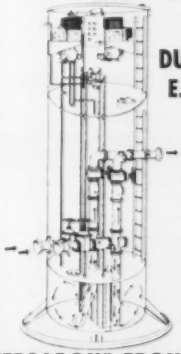
### *Smith & Loveless* "WAY-O-MATIC" FACTORY-BUILT SEWAGE EJECTOR

Ideal for installations requiring 200 G.P.M. or less. The "Way-O-Matic" Ejector practically eliminates maintenance as the sewage does not come into contact with any of the controls. Built of finest materials to provide maximum performance at factory-built prices. The "Way-o-matic" may be ordered as a separate unit or in a complete lift station. Cutaway drawing shows operating principle.

### *Smith & Loveless* "MON-O-JECT" FACTORY-BUILT SINGLE PNEUMATIC EJECTOR STATION

Designed for small installations of 200 G.P.M. or less. Completely automatic, extra large air storage. Requires minimum maintenance. Built of the finest materials and meeting the same high standards set by all Smith & Loveless lift stations. The "Mon-O-Ject" provides high-quality equipment for the modest budget. Requires minimum space underground. Cutaway drawing shows construction details.

### *Smith & Loveless* "DU-O-JECT" FACTORY-BUILT DUPLEX PNEUMATIC EJECTOR STATION



Most small sewage lift projects are served most economically and dependably by the Smith & Loveless "Mon-o-ject" single pneumatic sewage ejector lift stations. Where duplex equipment must be provided, the Smith & Loveless "Du - O - Ject" meets the requirements most economically. Cutaway drawing shows construction details.

**ALL S&L PRODUCTS ARE PERMANENTLY PROTECTED WITH S&L "VERSAPOX" EPOXY COATINGS**

**MAKERS OF WATER AND SEWAGE TREATMENT EQUIPMENT**

S&L *Smith & Loveless, Inc.*

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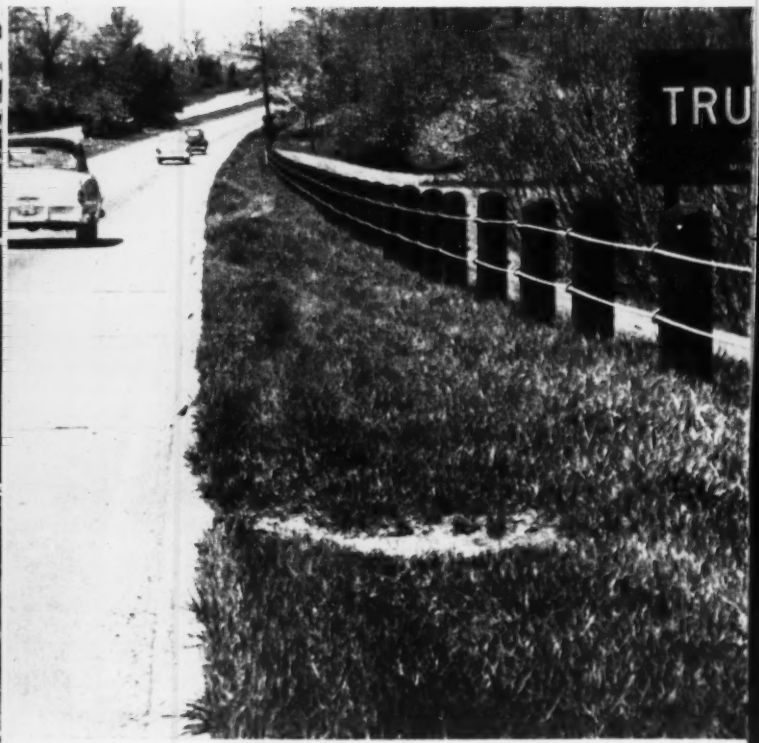
REPRESENTATIVES IN PRINCIPAL CITIES

For job recommendations, complete specifications, dimension drawings, capacity charts, etc., all part of the latest Smith & Loveless lift station data manual.

**WRITE DEPT. 80**

No obligation.

**Mr. Clinton Peterson,** Division Engineer of Maintenance, examines a pressure-creosoted post.



Posts untreated rot out in 5 to 10 years.

**The Merritt Parkway** in Connecticut, opened in 1938, was one of the first of the modern toll roads. The original rustic guard rails were generally of oak or chestnut dipped in a preservative bath. These showed early signs of deterioration according to Mr. Clinton R. Peterson, Division Engineer of Maintenance. Some of the posts lasted only five to ten years and replacement was costly.

Obviously a change had to be made to save taxpayers' money. Wood preservation experts from the highway department, a university forestry school and the Connecticut Agricultural Experiment Station began a study. After much experimentation, the conference reported

# Pressure-creosoting doubles the life of guard rail posts on Merritt Parkway

**135,000 feet** of guide railing, supported by pressure-creosoted posts, is used on the Merritt Parkway. Note the reflectors on the posts for night visibility.

that *pressure treatment with creosote was the preferred choice of all these authorities.* At that time, full-length pressure-creosoted posts were made the standard in the state. Pressure-creosoted posts have a life expectancy of 25 to 30 years.

The original rustic railings were replaced with steel cable guard rails firmly supported by pressure-creosoted posts. The domed-top post was favored for its looks and water shedding ability. Some beveled-top posts were used and appear to have about equal life.

This experience on the Merritt Parkway and other Connecticut highways verifies the results being obtained all over the country. The deep penetration of pressure creosoting is needed to assure adequate protection—not only from rot but from termites and other wood destroying insects as well.

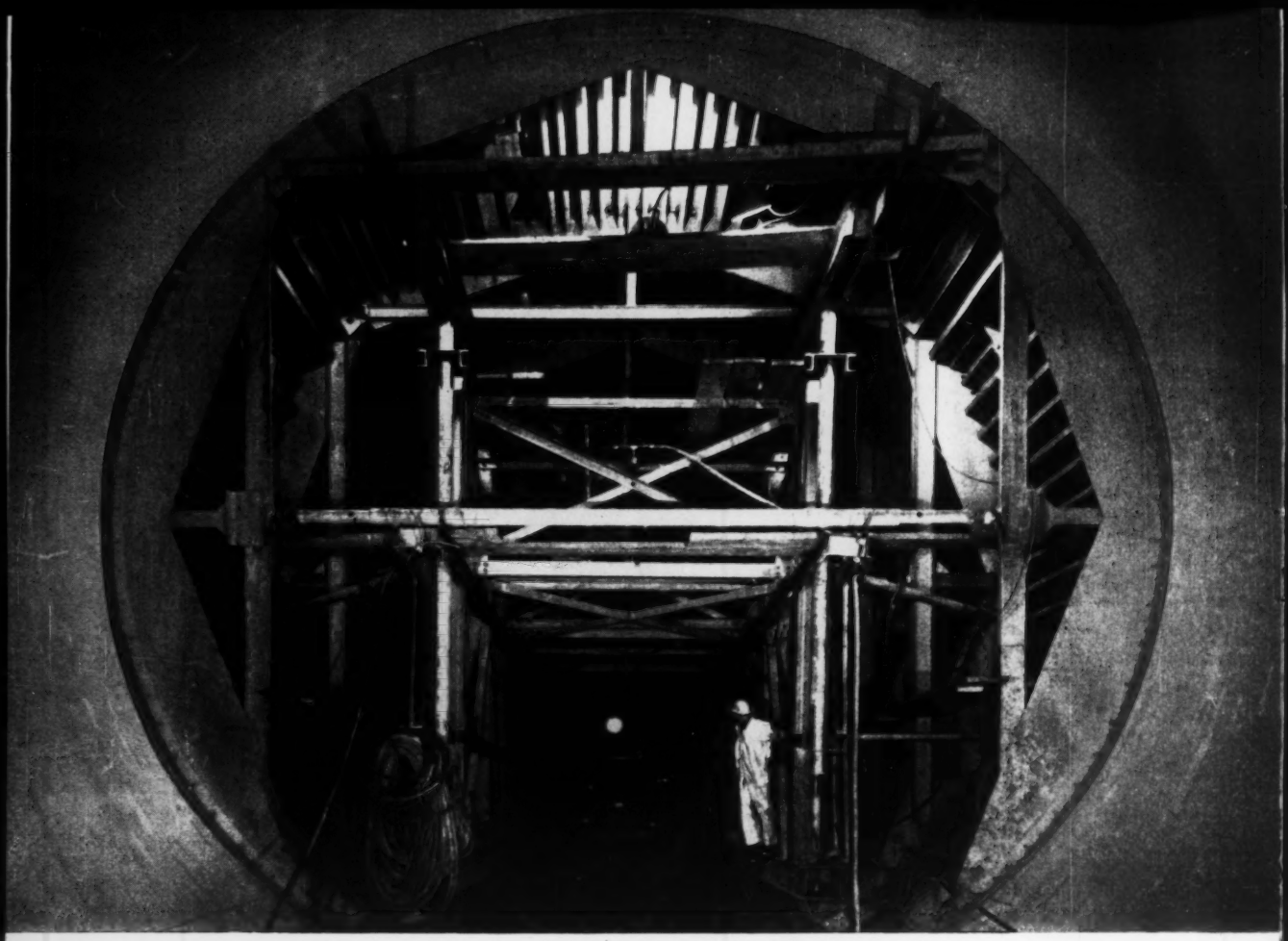
**U. S. Steel does not make pressure-creosoted posts but supplies much of the creosote used by the treating industry. Why not take advantage of this easy way to reduce highway costs? Pressure-creosoted posts are readily obtained in most areas. For information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.**

*Creosote's Past Assures Wood's Future*

USS Creosote

TRADEMARK

**Sales Offices in** Pittsburgh, New York, Chicago, Salt Lake City and Fairfield, Alabama.



Design of traveler permits vehicular operation through tunnel while form is in place. In addition Blaw-Knox developed and built a concave screed for the tunnel invert.

# Concrete Forming time cut by 33% on Trinity Dam Diversion Tunnel

*Single Blaw-Knox Tunnel Form moving on rubber-tired traveler is handled by six man crew*

More than 30,000 cubic yards of concrete have been poured in the construction of the 2,570 foot long, 28-foot diameter diversion tunnel at the Trinity Dam Project at Lewiston, California. To speed forming operations, Trinity Dam Contractors chose two specially designed Blaw-Knox Tunnel Forms, each 50 feet long, equipped with two rubber-tired travelers each.

The Blaw-Knox Forms can be set, stripped, and reset without disassembling any of its components. Each set of wheels is equipped with a ratchet device to permit steering of the traveler around horizontal curves. Despite its weight, the form is moved by two men operating hand winches. Elevation is controlled by a series of hydraulic jacks, and sidewall adjustments are made with steamboat ratchets. Telescoping pipe spreaders support sidewalls during pouring.

With these specially designed units, Trinity Dam Contractors poured every day, alternating between forms, allowing 16 hours set-up time. Using other methods, a maximum of only two pours a week would be possible. Guy F. Atkinson Company is sponsor of the $49,000,000 joint venture. Other joint venturers are: M. J. Bevanda Co., Inc., Chas L. Harney, Inc., Ostrander Construction Company, A. Teichert & Son, Inc. and Trepte Construction Co.

You can put the know-how of Blaw-Knox Steel Forms Engineers to work on your concreting problems. You'll get the benefit of 40 years experience translated into versatile, rugged equipment designed to help increase your profits. Call on the Blaw-Knox Steel Forms Consultation Service for planning help now. There's no obligation, of course.

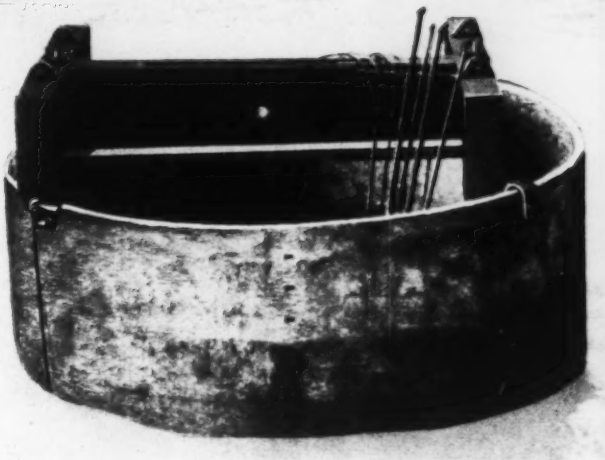
BLAW-KNOX

**BLAW-KNOX COMPANY**

*Blaw-Knox Equipment Division · Pittsburgh 38, Pa. · Phone STerling 1-2700*

ingenuity: (ĭn′jē·nū′ĭ·tĭ), n.,
skill in planning, inventing

# MACCO HAS IT--
# MACCO APPLIES IT!



**SUBAQUEOUS PIPELINE INSTALLATION**

Over the past 30 years, MACCO has gained experience, job-bred know-how and engineering ingenuity second to none in the industry.

For example: In the course of completing a major Pacific Coast subaqueous pipeline project, MACCO engineers determined that it would be best to design and pre-cast the 350-ton light-weight concrete terminal structure, 20′ diameter x 34′ high, as a stable floating unit. This was done.

Then the huge vessel was towed 23 miles over open ocean, from the casting site to its installation point 2400 feet offshore. Here, specially engineered rigging and stationary equipment provided the control necessary to sink the structure into position.

By following this revolutionary procedure, never before accomplished in subaqueous pipeline installation, MACCO saved its client many thousands of dollars.

Here then, is what we mean when we say that planning, preparation, versatility and engineering ingenuity are *all* integral parts of solving construction problems; *and solving construction problems is a MACCO specialty!*

We're capable — and we're interested in working for you!

MACCO

## MACCO CORPORATION

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**RECENT MACCO SUBAQUEOUS PIPELINE PROJECTS**

SCATTERGOOD STEAM GENERATING PLANT
Playa del Rey, California
for Los Angeles Department of Water and Power

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Huntington Beach, California
for Southern California Edison Company

STEAM GENERATING PLANT
El Segundo, California
for Southern California Edison Company

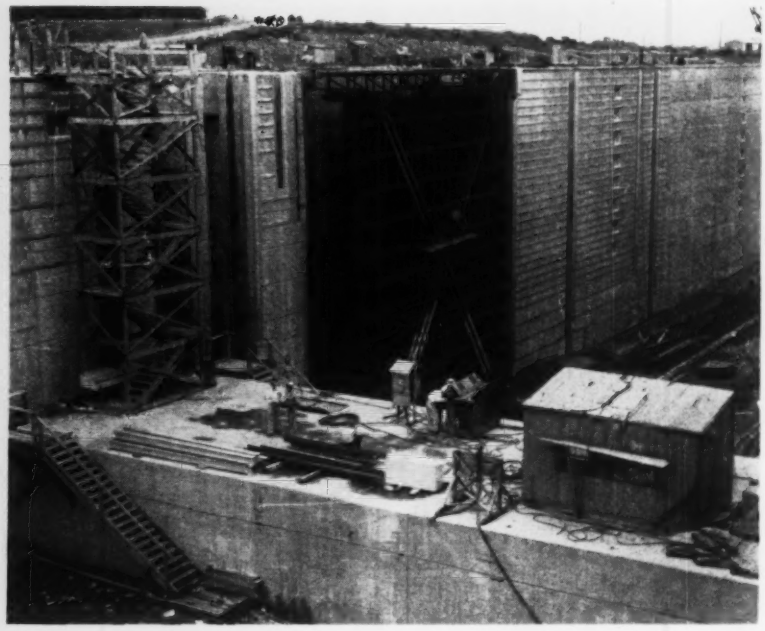
STEAM GENERATING PLANT
Redondo Beach, California
for Southern California Edison Company

WASTE WATER DISPOSAL LINE
El Segundo, California
for Standard Oil of California Refinery

# EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

## New Method for Old Dam Job



THE METHOD SPECIALLY DEVISED to increase the tensile strength of tension bars to plumb lock gate leaves is as modern as the new Markland Locks and Dam, which will replace five smaller locks near Madison, Indiana.

On this job, Penn-Southern Construction Co. is fabricating and installing the lock gates which consist of two leaves each weighing 250 tons. The leaves are of all welded construction and are equipped with diagonal tension bars to keep them plumb. There are three tension bars running diagonally from the top quoin side of the leaf to the bottom miter side and two tension bars running diagonally from the top miter side to the bottom quoin side of the leaf.

One of the major problems of installing and adjusting lock gates in the past has been the method of pre-stressing the tension bars to plumb the leaf. Not only at the time of installation, but all future adjustments were made by using steamboat jacks at different points on the leaf and tightening up the turnbuckles on the bars. This method was not only slow, difficult and costly, but necessitated the pumping out and closing down of the lock for as much as 30 days at a time. Therefore, Penn-Southern in collaboration with the engineers from Hobart Bros. Co. came up with the idea of expanding or prestressing the tension bars with induction heat. **Hobart Brothers, CE-12, Hobart Square, Troy, Ohio.**

## Turning Conveyor

DESIGNED TO CONVEY AROUND a curve any type of sheet and board material during manufacture, distribution or fabrication, this 5-ft wide conveyor was developed at the request of the gypsum board industry and is well suited to such other products as plywood, hardboard, sheet metals, paper and plastics. Grooved rollers and wire spring belts transmit power from shaft to shaft in a circular path, a feature of all the company's bag and package loaders, elevators and conveyors. The turning section has a 6-ft centerline radius using graduated discs keyed to spring belt driven shafts. The top surface is perfectly level but gives controlled turning action to sheets, either singly or in stacks. Curved sections can be provided for any circular arc and coupled to straight sections of any length, all driven by a single power drive. **Power-Curve Conveyer Co., CE-12, 2185 S. Jason St., Denver 23, Colo.**

## Ply-Tie Holder

AN UNUSUAL FASTENING DEVICE for plywood concrete forms which holds both the form tie and waler in place has been developed. The fastening device is a bracket called a Ply-Tie holder, designed for use with conventional fir plywood panels. One arm of the bracket has a teardrop slot which fits over the head of a special form tie. The other arm of the bracket holds the waler.

With the new system, the tie holes are pre-drilled in the plywood, using a standardized pattern. Then, the contractor tacks 2 x 4 studs to the plywood with one of them backing the joint. The holder secures the form tie and holds the waler in place. As the waler drops into a procession of holders along the entire length of the wall, a minimum of nailing is necessary. The form work can be quickly stripped by springing the walers loose and releasing the tie holder with the tap of a hammer. The same holder can be used for light, medium or heavy construction by varying the spacing the thickness of studs and walers. Since standard panels of fir plywood are used, there is no problem of hauling prefabricated forms to the job site. **Trueforms, Inc., CE-12, 414 Times Square Bldg., Seattle 1, Wash.**

## Non-Automatic Tongs

ADDED TO THE COMPANY'S STOCK ITEMS are non-automatic tongs for pulling wood sheet piling and legging. The jaws are shaped to present a maximum of bearing surface against the pile. Each jaw has five teeth that bite into the wood transversely to the grain.

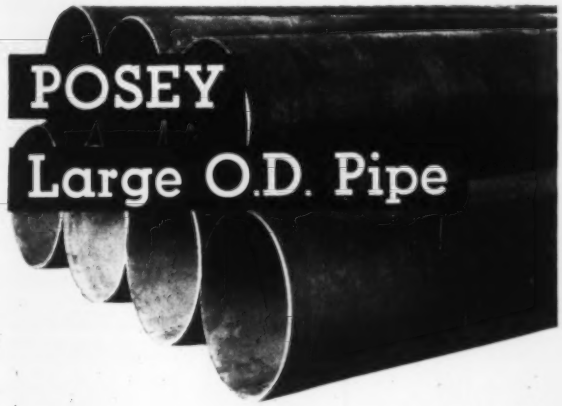
A link at one side holds the jaws open when the tongs are lowered over a load. This link is dropped out by allowing a bit of slack in the line, whereupon the jaws close on the piling and hold it firmly. When the load is delivered, it is a simple matter to put the link in position again, holding the jaws open for another load. The tongs have a pulling capacity of 10,000 lb and a nominal jaw opening of 3 in. **Heppenstall Co., Materials Handling Div., CE-12, New Brighton, Pa.**

## Snubbing Load Binder

A LARGE COIL SPRING shock absorber built into the Snubbing Load Binder eliminates the "extra link" problem encountered with ordinary binders.

The spring takes up slack without excessive tightening, and maintains proper tension, even if the load shifts slightly in transit, therefore preventing damage to loads such as gas cylinders, large tanks and building stone.

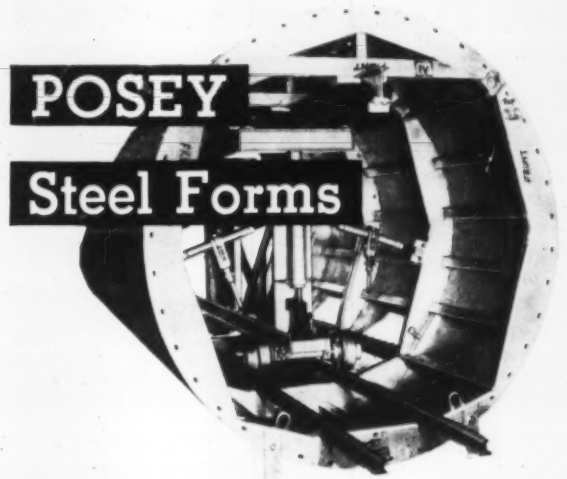
Other features of the binder include flanging of the handle at leverage point to prevent spreading, and a heel which toggles away from the load to permit easy release. Ball and socket swivel joints on both hook assemblies make connections easier and assure a constant straight line pull. **Crosby-Laughlin Div., American Hoist & Derrick Co., Box 570 FV, CE-12, Fort Wayne, Indiana.**



# POSEY
## Large O.D. Pipe

Fabricated from carbon steel, stainless steel, nickel clad, stainless clad, monel clad, wrought iron . . . from 14" diameter and larger . . . for a wide variety of applications. Piling, dredge pipe and accessories for the pipe line are our specialty.

*— Steel Plate Division*



# POSEY
## Steel Forms

Telescoping and non-telescoping forms for tunnels, sewers and conduits . . . air locks and lock doors for concrete bulkheads . . . jumbos for drilling, timbering and concreting . . . head frames, cages, special muck cars, muck bins and self-dumping skips . . . special equipment for underground construction.

*— Tunnel and Mine Equipment Division*

SINCE 1910 we have specialized in steel plate fabrication. Posey Iron has a wide background of engineering experience and know-how. Let us quote on your next job.

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# EQUIPMENT, MATERIALS and METHODS

**(continued)**

## Rotary Blasthole Drill

THE NEW MODEL RR10 ROTARY drill has enabled mine operators and contractors to utilize large-diameter holes with low-cost explosives, according to the manufacturer. By drilling larger holes on wider spacings, obtaining fast penetration rates and using low-cost explosives, the entire cost of drilling and blasting in nearly all types of materials, has been greatly reduced.

Some of its features are: three hydraulic jacks level the drill even on a 15% grade; a 600-cfm rotary compressor mounted on the front of the tractor provides air for the removal of cuttings; and for long-distance transport, the entire drill mast and compressor can be easily removed and loaded on a carrier. **Robbins Machine & Manufacturing Co., Inc., CE-12, P.O. Box 281, Oneonta, Ala.**


"Mayer's Grand Guide"

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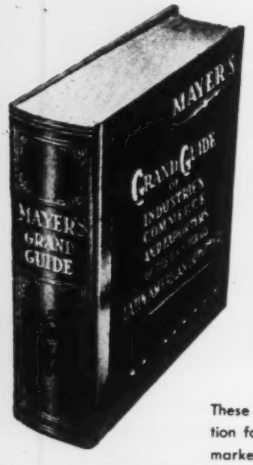


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## Elbow Eyepiece

A NEW ELBOW EYEPIECE was developed to fill the need for an instrument which will be easier to read in the field. It extends in a diagonal direction from the end of the Alidade telescope and can be rotated in any position and read from either side.

Previously it has been necessary for the observer to place his eye close to the telescope and, at a position which is sometimes awkward and inconvenient. The new eyepiece permits the topographer to view his target with greater comfort and convenience.

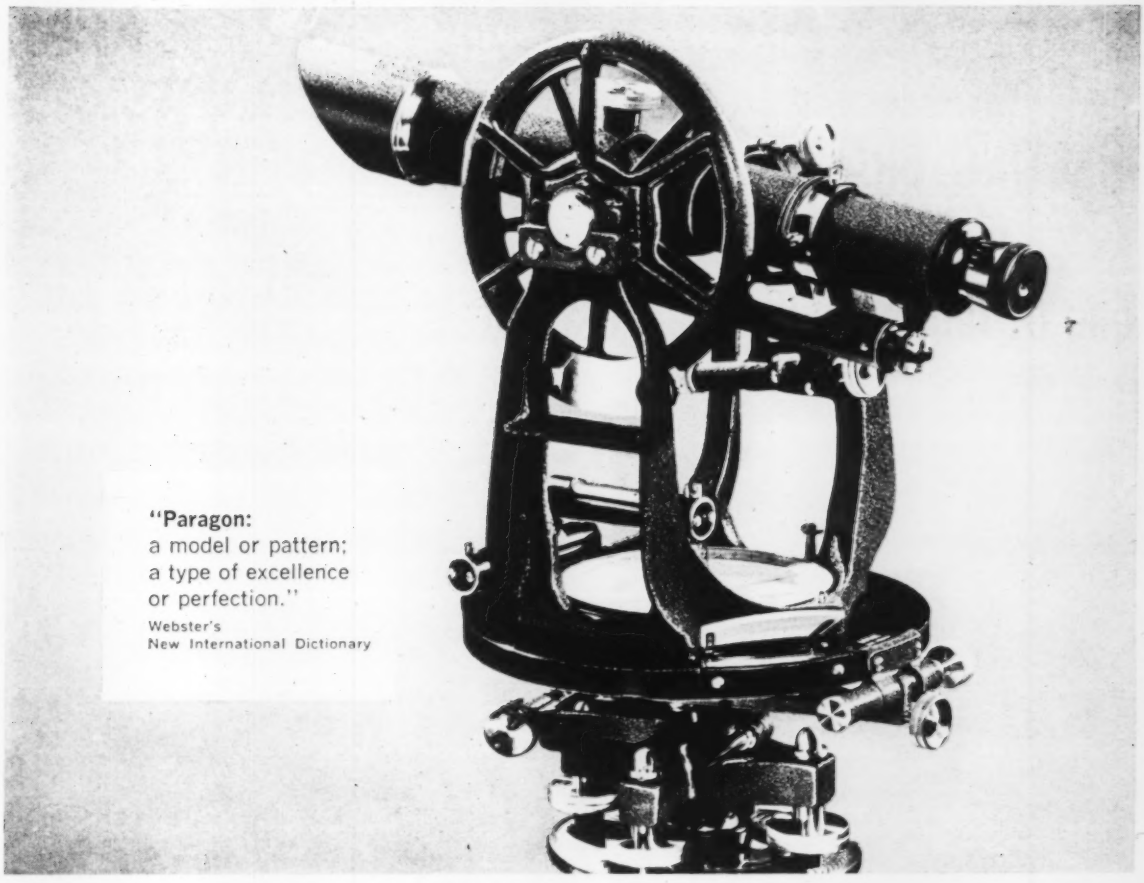
Greater Comfort and Convenience

Instrument men who have used pilot models state that the Alidade is now easier and faster to use and that there is less danger of the instrument's being accidentally moved out of position. Men who wear glasses report that there is no longer a problem in getting the eye close to the eyepiece. **W. & L. E. Gurley, CE-12, Station Plaza, Troy, New York.**

## Earth Rammer

THIS ONE-MAN OPERATED, 220-lb, gasoline powered self-contained earth rammer, featuring a positive carburetor, automatic built-in lubrication system, positive control for safest possible operation, and maximum compaction, jumps to a height of 18 in., 80 times per minute, exerting 311 ft lb with each blow, on lifts up to 24 in.

The action of the machine is simple and effective; the combustion chamber is "primed" with gas by means of a lever conveniently placed on the side of the machine. When the ignition is accomplished by squeezing the striking handle on the handle bar, the machine jumps and additional fuel is pulled into the cylinder for the next jump cycle. Because the impact of its return to the ground and the reaction of the next jump compact the soil, no additional priming is required. The Maxtamp offers safety of operation as it will not jump again unless the magneto handle is squeezed. **Complete Machinery & Equipment Co., Inc., CE-12, 36-40 Eleventh St., Long Island City 6, N. Y.**



"Paragon:
a model or pattern;
a type of excellence
or perfection."
Webster's
New International Dictionary

# In Transits too, K&E Paragon sets the pattern of perfection

The superior optical qualities and precision operation which K&E builds into the Paragon Transit® are designed to last a lifetime and offer the maximum in performance and ease of use. Compare the Paragon with other transits, feature by feature. Only the K&E Paragon Transit has all five of these important advantages:

**1. A Completely Enclosed Achromatic Telescope** . . . with an achromatic eyepiece *as well as* an achromatic objective lens. It sights clearly and sharply, with less eye strain. Enclosed telescope is fully sealed, stays free from dust and moisture.

**2. Chrome Plated Draw Tube** . . . with one of the hardest bearing surfaces known to man. Tube cannot wear as it moves back and forth on bearing rings, so line of sight remains stable.

**3. Stainless Steel Axle Journals** . . . for the best possible bearing surface. Ease of operation is retained no matter how many times you change the telescope from the direct to the reverse position.

**4. One-Piece Spanned Vernier Disc** . . . to make sure that the verniers always stay exactly 180 degrees apart. Even under the roughest, most demanding field conditions, angle readings of the Paragon Transit will stay true.

**5. Chrome Plated Center** . . . combines the toughness of non-brittle forged Everdur with the hardness of chrome.

*Naturally, because the K&E Paragon Transit is the best, it costs a little more than ordinary transits. But see for yourself how much more it has to offer. A call to your K&E representative will quickly arrange for a demonstration. Fill out and send in the coupon below.*

1612

**KEUFFEL & ESSER CO.** Dept. CE-12, Hoboken, N. J.

Gentlemen: ☐ Please have a K&E representative show me the K&E Paragon Transit.
☐ Please send me more information about the K&E Paragon Transit.

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# SHEETING, BRACING, UNDERPINNING used for foundation of one of Jacksonville's largest hotels

1. SOLDIER BEAMS, HORIZONTAL SHEETING AND BRACING
2. EXISTING BUILDING UNDERPINNED

*Project:* Robert Meyer Hotel, Jacksonville, Fla.
*Architect:* William B. Tabler, New York City
*Engineers:* Seelye, Stevenson, Value & Knecht, New York City
*General Contractor:* Daniel Construction Co., Jacksonville, Fla.

The site of this 19-story, half-block-square hotel in Jacksonville was nearly all sand. The foundation required several kinds of specialized work, which were awarded to Spencer, White & Prentis.

Soldier beams, horizontal sheeting and bracing (see photo) were used on 3 sides. This type of support made it unnecessary to cope with heavy hydrostatic pressure, since the openings between the sheeting permitted drainage during Florida's tropical storms.

Pit underpinning secured the J. C. Penney building, at right.

Whatever your foundation problem and wherever your job is located – whether South, North, East or West – Spencer, White & Prentis is equipped to give complete dependable service.

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## EQUIPMENT MATERIALS and METHODS

(continued)

### Dragline Bucket

A 69,000-LB TRI-TAPERED dragline bucket has recently been completed. Weighing as much as 20 automobiles, it has a capacity of 35½ cu yd. The loaded weight will be approximately 175,500 lb.

Alloy 12M and manganese steel castings along with US Steel's T-1 plate are the materials used in the bucket. The drag chain is integrally cast, each link

Tri-Tapered

weighing 90 lb, and the teeth weigh 177 lb each.

The average width of the bucket is 11 ft 2 in., height from the ground to arch, 13 ft 5 in. and the overall length is 18 ft 9 in. Two and three quarters inch wire rope will be used for the hoist cable and the drag cable will be three and one eighth inches in diameter. **Electric Steel Foundry Co., CE-12, 2141 N.W. 25th Ave., Portland 10, Ore.**

### Electric Heaters

ASPHALT SUPPLIERS SOLVE THEIR heating problems by using a variety of Chromalox electric heaters, according to the manufacturer. Keeping a thick, viscous mass of asphalt flowing smoothly used to require a high pressure steam system with a high operational and maintenance cost. Starting up operations after a weekend shut down or even over night is costly and time consuming. Inferior mixes resulted from inconsistent heating and moisture. Conversion to completely automatic electric heat is a simple operation because of the variety of rugged heaters, thermostats and contactors easily adapted to different jobs. Hairpin tubular heaters and thermostats are inserted into storage tanks. Transfer pipes, mixers, gates and valves may be heated with straight tubular or flat strip heaters in tight contact and insulated to keep the heat in. The irregular shapes of pumps

*(Continued on page 136)*

# What's in a name?

In some cases, you'll never know. In other cases, it's clearly evident. Here, in the above illustration, you have the obvious and the obscure. Two reels of what appear to be identical prestressed strand. At this point, the similarity ceases.

It is from this point that most buyers of the "guess who" strand are strictly on their own. In most cases they can't find out who made it even when they want to. Except to learn that it comes—like cinnamon—from a distant shore. If something goes wrong, these buyers find that they get nowhere at all when they pick up the telephone and ask for the Distant Shore Operator.

Our illustration is not in any way big enough to show you what is behind, and *what preceded* the reel that identifies itself, and the superior product that is on this reel. It's difficult to *show* fourteen years of experience in the prestressed concrete field, to show the engineering knowledge and assistance that is yours whenever you want or need it. It's all there, though, and you can get it by communicating with Construction Materials Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

**Consult Roebling . . . First in the U. S. with Prestressing and Tensioning Elements**

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**BIG JOB**
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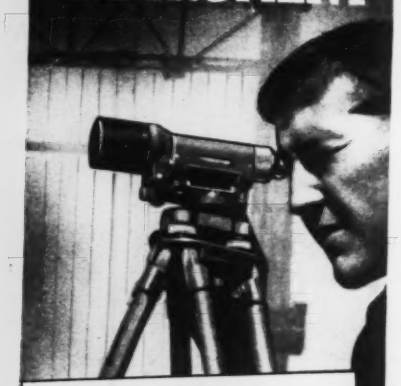

**WORLD FAMOUS**
precision surveying instruments... compact, rugged construction... fast, effortless operation. More reliable results in less time.

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**precise level**
in use at Gloucester Anchorage of new Walt Whitman Bridge being constructed over Delaware River. (Modjeski & Masters, Ammann & Whitney, Consultants to the Delaware Bridge Authority of Pa. and N. J.)

**DESIGNED FOR HIGHEST PRECISION LEVELING**

- Functional, down-to-fundamentals design—only 4½ lbs. (8 lbs. with carrying case).
- Coincidence level and fine tilt screw.
- Readings at a glance—level and rod may be read simultaneously through 30x Telescope.
- Mean leveling accuracy under normal conditions ± .008 ft. per mile.
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**PROMPT, RELIABLE SERVICE**
**FACTORY TRAINED PERSONNEL**

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*The FINEST in SURVEYING EQUIPMENT*
**KERN INSTRUMENTS INC.**
120 Grand St., White Plains, N.Y.

# EQUIPMENT, MATERIALS and METHODS

**(continued)**

and valves lend themselves to Chromalox high temperature Thermwire. Temperatures may be varied by a simple setting of the thermostat, from 130-deg F for weekends to 325-deg F for normal operation. Automatic timing devices permit presetting of working temperatures. **Edwin L. Wiegand Co., CE-12, 7500 Thomas Blvd., Pittsburgh 8, Pa.**

## Ready-Mix Concrete Trucks

TWO NEW READY-MIX concrete trucks, one with an extra heavy front axle have been designed to meet special area weight restrictions.

The C6-547 is a 54,000-lb gross vehicle rated truck with an 18,000-lb front axle and rear tandem axles rated at 36,000 lb. The truck is designed to carry maximum legal loads in areas which permit upwards of 49,000-lb gross vehicle weight

Model C6-547

on a three-axle truck but where weight on the two rear axles combined is limited to 32,000 lb.

The other new truck, Model C6-405, is designed to carry maximum legal loads in areas where the legal GVW is limited to 42,000-44,000 lb and where 32,000-lb loads on the tandem rear axles are permitted. Equipped with a 5-cu yd mixer, the truck will scale legally with 5 to 5½-cu yd loads in such areas. **Four Wheel Drive Auto Co., CE-12, Clintonville, Wisconsin.**

## New Levels

THREE OF THE NEW INSTRUMENTS which have been announced by the company—a Transit-Level, a Dumpy Level and a Hand Level—comprise a popular-priced group called the "Speed-A-Liner" series. Instruments in the series have similar functional-modern styling and they offer greater ease of operation and incorporate advanced design features unusual in their price class.

The fourth instrument is a newly engineered 1959 model of the Convertible Transit-Level. Called the "Master Builder", it offers extra strength without the addition of more weight and provides the builder and contractor with many big-instrument features at a modest price. **C. L. Berger & Sons, Inc., CE-12, 37 Williams St., Boston 19, Mass.**

## Digging Chisel

FROSTED GROUND SURFACES GIVE way easily to the long, perfectly forged and heat treated blade of the digging chisel, making it ideal for deep digging of frozen ground and cutting of soft shale, etc.

There are three shank sizes: 1 in. x 4½ in.; 1⅛ in. x 6 in. and 1¼ in. x 6 in. The length under the collar of the first tool is 17¼ in., and of the other two—16½ in. The blade size of the first tool is 3 in. x 10 in., and the others—3 in. x 12 in. **Brunner & Lay, Inc., CE-12, 9300 King St., Franklin Park, Ill.**

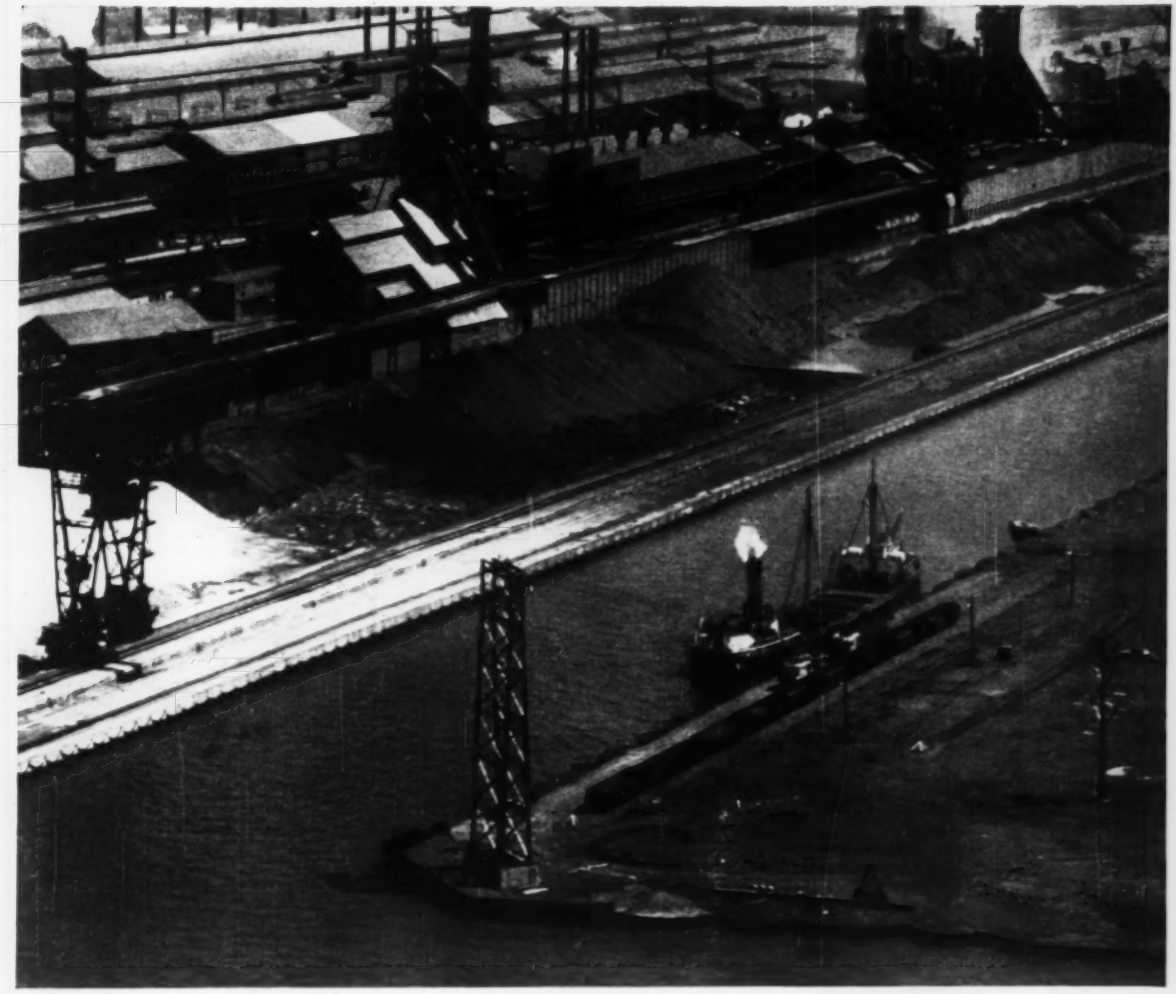
## Controlled Volume Pumps

THE NEW MILROYAL LINE of controlled volume pumps for the chemical processing industries approaches the ultimate in design objectives for liquid chemical feeders evolved from more than 20 years of experience with tens of thousands of controlled volume pumps in continuous operation throughout the world.

One design objective realized is the use of a minimum of working parts and

Minimum Of Working Parts

bearing surfaces to translate high speed rotary motion to low speed reciprocating motion. Totally enclosed, this speed reducer is an integral part of the pumps and runs in an oil bath. This combined Polar-Crank drive unit and speed reducer permits manual or automatic adjustment of capacity from 0 to 100%. The capacity adjustment closely approximates a liner relationship and can be made while the pump is running. **Milton Roy Co., CE-12, 1300 E. Mermaid Lane, Philadelphia 18, Pa.**



# GREAT LAKES INDUSTRIAL CANAL DEEPENED TO ACCOMMODATE VESSELS OF GREATER DRAFT

The St. Lawrence Seaway will have an enormous impact on Great Lakes ports. Channels will be dredged deeper and docks rebuilt to handle the larger capacity ships that will eventually sail 2300 miles into the North American heartland.

The Seaway, expected to be completed in 1959, will add more than 8000 miles of new coastline to the United States and Canada. Much of this inland waterway is already navigable, and only dredging and deepening will be necessary to meet the Seaway's 27-ft channel specifications.

At Buffalo, the ship canal shown above was deepened from 23 ft to 29 ft. To accomplish this, a new steel-piling dock front had to be constructed, extending the walls down to the new canal bottom. Various types of dock wall construction were used, employing many thousands of tons of Bethlehem steel Sheet and H-Piling. The docks, which serve the plant for receiving raw materials and shipping finished steel products, have a length of nearly 10,000 ft.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

**BETHLEHEM STEEL**

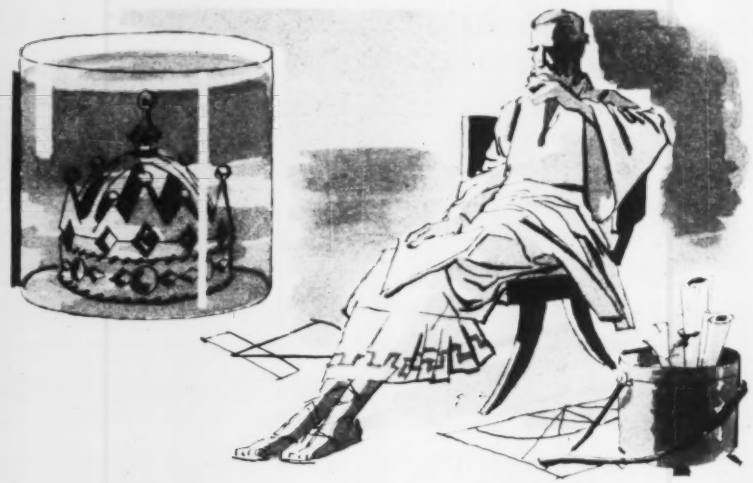
BETHLEHEM STEEL

### Auto-Vator

A NEW ALUMINUM AUTO-VATOR with "E-Z Up" trailer offers building contractors a fully automatic material hoist that can be moved from job to job and set-up ready for operation in just minutes by one man.

Excessive erection costs and trucking worries are eliminated as the Auto-Vator is constructed of lightweight aluminum and the "E-Z Up" trailer unit hooks on to any car or truck. When hauled to job location operator unhooks and tilts into working position. Legs lock to form a stable "A-Frame" tower.

The Auto-Vator has remote control, adjustable platform stops and side unloading, telescopes up to a height of 40 ft, with extensions available for greater heights, and is powered by gas or electric motor. **Engineered Equipment, Inc., CE-12, 1001 Linden St., Waterloo, Iowa.**



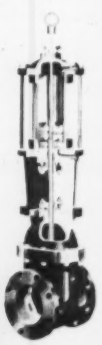
# The Birth of HYDRAULICS

"Eureka!" (I have found it) cried the famous Greek sage Archimedes in the 3rd century B. C., as he discovered the principle of water displacement. But not until the 16th Century, A. D., many hundreds of years later, was the science of hydraulics really created when the French built the famous Fountains of Versailles near Paris.

Because water supplies are vital to life, ancient villages and camps had to be located near lakes or streams. Today, our modern civilization could not exist without the science of hydraulics which makes it possible to convey potable water in large quantities to distant centers of population. Instead of people going to the water, we now take the water to the people.

To a large extent, the men who manage and supervise our modern water distribution systems are unsung heroes. Like the stars in the sky or the cream in your coffee, they are "taken for granted." We believe that they deserve greater public recognition of their service.

*This Series is an attempt to put into words some appreciation of the water works men of the United States.*

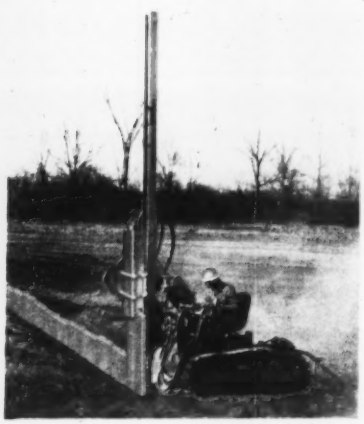


M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

### Trac-Hammer

A NEW TRAC-HAMMER that can be used for a variety of concrete breaking, pile driving or drilling operations has been announced.

It is an application of the Vulcan Portable Pile Hammer adapted for use on Gardner-Denver's "Air-Trac" drilling rig. Through the self-propelled "Trac" design and the location of the mast on which hammer and drill are interchangeable, the rig can work indoors, reach corners, curves and perform in other areas formerly considered inaccessible with mobile equipment. As the first construction machine of its type, it offers users one machine that can be adapted for drilling and pile-driving duties previously requiring two separate rigs.



All-Angle Boom

Towing its own compressed air supply, the machine features an all-angle boom enabling it to drive piles or drill holes from virtually every position. **Gardner-Denver Co., CE-12, 100 Williamson St., Quincy, Ill., and Vulcan Iron Works, CE-12, 327 N. Bell Ave., Chicago, Ill.**

### Gismo Transloader

A ONE-MAN OPERATED self-loading and self-dumping transport has been developed. A self-loading truck that shuttles back and forth between muck pile and the dumping point without the synchronization of several pieces of equipment or positioning of equipment to load, the

*(Continued on page 140)*

WHEN AMERICA BUILDS FOR ECONOMY . . . IT BUILDS WITH CONCRETE

*Design: Bridge Section, Ft. Worth District, Texas Highway Department*
*Contractors: Austin Bridge Company, Dallas, Texas and Worth Construction Company, Ft. Worth, Texas*

FOUR-LEVEL INTERCHANGE AT FORT WORTH . . .

## reinforced concrete bridges provide needed clearances with minimum over-all height

To meet Interstate standards for this direct-connect interchange in a restricted right-of-way, Texas highway engineers chose the shallowest possible construction. (Minimum vertical clearance for each deck is 14 ft. 6 in.) They used 2,945 linear feet of reinforced concrete bridges, of haunched slab design. These structures with their clean lines are attractive as well as efficient.

Concrete used this way saved money, too. Costs have run as much as 17% lower than for similar structures of competitive materials. Concrete saves time by being readily available, makes scheduling easier. Forming problems are simplified for fitting curves and varying elevations. There are no complicated shop details.

And with concrete, engineers can plan on lowest maintenance expense, extra long life. Write for free literature on concrete grade-separation structures. Distributed only in the United States and Canada.

**PORTLAND CEMENT ASSOCIATION**
**Dept. 12-13, 33 W. Grand Ave., Chicago 10, Illinois**
*A national organization to improve and extend the uses of concrete*

FOR STRUCTURES... MODERN **concrete**

**The continuous reinforced concrete slab** guaranteed minimum overall height with required vertical clearance for lower roadway levels.

Gismo Transloader keeps working full shift—loading, transporting and dumping in continuous, uninterrupted performance-cycles.

The Transloader offers unusually low cost capital investment to do a given job, as well as the lowest possible cost per ton for labor and maintenance. There is positively no jackknifing in mucking operation. There is no turning or positioning for loading. The machine travels equally as well either direction. **Sanford-Day Iron Works, Inc., CE-12, Dale Ave., Knoxville, Tenn.**

Self-Propelled

## Pneumatic Compactors

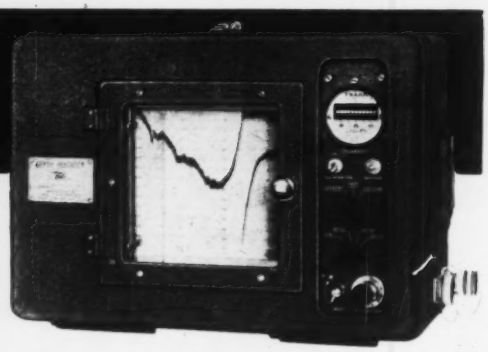
SELF-PROPELLED, MULTI-TIRE pneumatic compactors in a range of sizes from 9 tons to 30 tons; 9 wheel to 15 wheel units have been developed. The driver sits on a swivel seat at the rear corner of the machine so he can see the wheels when rolling close to curbs or walls. He can also face either forward or rear to eliminate turn arounds and can steer the machine in either direction of travel. The entire machine can turn within a 26 ft radius circle.

Vertical travel action on each wheel with equal weight distribution to all wheels gives more even compaction over the entire rolled area and prevents soft spots in the finished surface. Simplicity and accessibility of driving parts facilitates service on this piece of equipment. The ballast compartment is made water tight, therefore sand, gravel or water may be used at ballast. **Eskridge Equipment Co., CE-12, 1214 S. Norwood Ave., Tulsa 12, Oklahoma.**

Edo

**Model 255A**

**SURVEY DEPTH RECORDER**



Edo Model 255A Survey Depth Recorder, designed expressly for underwater dredging and cable laying operations, employs an extremely narrow beam pattern (6° at −10 db) to obtain precise, detailed contour information. High operating frequency, 110 kc, minimizes penetration of silt or mud with the result that the recorder accurately pictures the soft bottom that is of concern in dredging.

Also available is Edo's Model 255B Survey Depth Recorder, with standard beamwidth (20° at −10 db), the ideal equipment for deep depth, penetration and general survey. With dual beam transducer, Model 255B can increase beamwidth to 40° at −10 db.

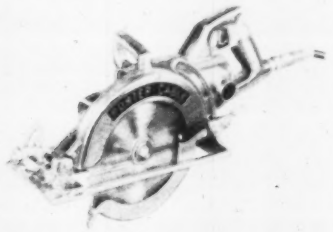
Edo Models 255A and 255B are both manually adjustable for transducer draft or sound velocity and record in eight overlapping ranges, 0 to 250 fathoms.

*For illustrated brochures, write Dept. V-12*

Edo CORPORATION, College Point, L. I., N. Y.

## Construction Saw

A NEW 7½-IN. POWER SAW, with reserve power, reserve capacity and many additional features for contractors, builders, carpenters and maintenance men has been introduced. Named the Model 533 Construction Saw, it has the blade mounted on the left of the motor for easier lining up of the cutting edge of the blade, sighting notch and line of cut. A special guarantee covers the repair of



Reserve Power and Capacity

all damage and any service necessary for a period of one year from date of purchase without charge to owner.

The saw is adaptable to all types of cuts from long rip cuts to compound mitres. By using Porter-Cable abrasive blades, the 533 will cut many types of materials such as iron, steel, marble, slate, non-ferrous metals, cement blocks, building brick, tiles, porcelain, pressed materials such as lucite, bakelite and other plates. **Porter-Cable Machine Co., CE-12, 1724 Marcellus, Syracuse, N. Y.**

## Helco Auto-Mix

CONCRETE USED IN THE MANUFACTURE of block can now be supplied automatically and precisely from bin to block machine without human error. Eliminating the operator now required to control the mixing cycle, the Helco Auto-Mix has been designed to operate in conjunction with automatic weighing equipment to complete the automation of the concrete supply process.

It can be operated either automatically or manually. Complete manual controls are provided both for the moisture control and mixer operations. The unit can be installed to operate with present automatic weighing systems and can also be used on a manual plant employing air electric gate operation. The control cabinet is completely dust tight. All external connections are conveniently labeled on one common terminal strip to facilitate installation. Numerous variations can be included with the unit. **Duffy, McClure & Wilder, Inc., CE-12, 400 Lincoln Bldg., Cleveland 14, Ohio.**

**Unusual Handling Technique** – Road clearances to Langley Field were not suitable for transporting the 53-foot long, 123-ton heat accumulator so Newport News made special loading and installation arrangements. The huge shell was first loaded on a "barged" trailer-truck and shipped to a location near the site. From that point it was pulled off by use of a ramp and hauled directly to the site where it was jacked into position.

# Tap the resources of Newport News to fill an order like this one

This 123-ton, stainless clad Carilloy T-1 steel heat accumulator, (probably the first vessel made of this type steel), was built for the Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics. This *special purpose* unit incorporates 70 years of metal working experience. Decades of machining, welding, stress relieving . . . fabricating millions of tons of steel into thousands of diverse products.

This experience goes into every unit built by Newport News . . .

Into products that range from small components of textile machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee. Newport News is a source for standard or special plate fabrication, castings, forgings, weldments and sub-assemblies. Particularly, large units . . . single or multiple. Your inquiries are invited.

A brand new, easy-to-read, illustrated booklet, *Facilities and Products* will show you scores of ways in which Newport News can help you. Send for it today.

**Newport News** Shipbuilding and Dry Dock Company
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**Engineers** – Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

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HYDRAULIC DREDGING

**GAHAGAN**

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Gahagan Dredging Corporation,
90 Broad Street, New York 4, N.Y.
Write, wire, or phone Whitehall
3-2558. Cable "Walgahagan".

# EQUIPMENT MATERIALS and METHODS

## (continued)

### New Finisher

OFFERING LAYING WIDTHS FROM 6 to 12 ft in 3-in. increments, the Model 873 asphalt finisher was designed to provide highest quality mats for such applications as paving driveways, parking lots, filling stations, and drive-ins. Received enthusiastically by small and large contracting organizations alike, for all work of this sort, it has been applied, with equal success, to other jobs such as paving shoulders along either asphalt or concrete highways, turnout paving and for the construction of acceleration and deceleration lanes along turnpikes, toll roads, etc.

Model 873

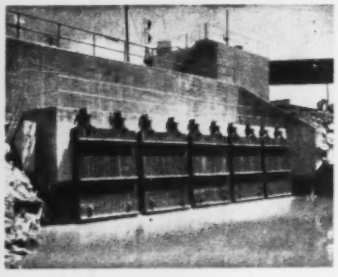
Its mounting manages to combine the stability and floatation of crawlers with the high speed job-to-job mobility of rubber tires. Since the applications for which the machine was particularly intended, most often involve unstable, soft, or recently primed bases, crawler mounting was essential to insure maximum traction with minimum bearing pressure. **Barber-Greene Co., CE-12, 400 N. Highland Ave., Aurora, Ill.**

### Herringbone Wire Rope

A NEW CONSTRUCTION WHICH combines the flexibility and abrasion-resistant characteristics of Lang lay rope with the structural stability of regular lay, has been developed. According to the manufacturer, in a series of exacting field tests, Herringbone proved extraordinarily versatile, and demonstrated unprecedented dual-purpose effectiveness, which for a wide variety of jobs will eliminate the expense and inconvenience of stocking two different types of rope. The wires in regular lay rope are laid in a direction opposite to that of the strands in the finished rope, while the wires in Lang lay rope follow the same direction as the finished strands. Herringbone rope is fab-

(Continued on page 134)

TIDE GATES

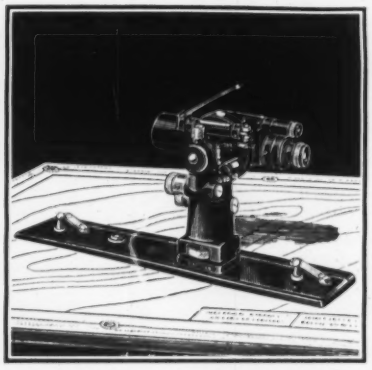


Five
12′ High x 9′ Wide
Type MMT Tide Gates
on Shockoe Creek,
Richmond, Va.

*Engineers—*
GREELEY & HANSEN
CHICAGO, ILL.

*Contractor—*
H. G. BOWLES
RICHMOND, VA.

BROWN & BROWN
LIMA, OHIO, U.S.A.



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FINEST IN THE FIELD

For swift accurate field mapping and surveying, leading surveyors rely on the Watts Microptic Alidade. The Watts Alidade is highly accurate, compact, light weight, versatile and dependable. See the advanced-design Watts Microptic Alidade with exclusive pillar levelling at your nearby Dietzgen Dealer. Made by Hilger & Watts, Ltd., London; sold and serviced in the United States by the Eugene Dietzgen Co.

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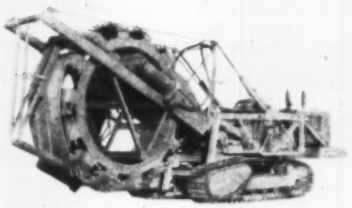
ricated of two pairs of Lang lay strands separated by two strands of regular lay. Thus the tough and relatively large outer wires will withstand the friction resulting from continued contact with sheaves, drums and other external objects, while the smaller and highly flexible inner strands enable Herringbone to sustain the most severe bending stresses. **John A. Roebling's Sons Corp., CE-12, Trenton, New Jersey.**

## Trenchliner

THE 420 TRENCHLINER, DESIGNED especially for pipeliners who must handle cross-country and other big trenching jobs, is now in production.

The giant digging wheel has three speeds—115, 215 and 300 ft per min. A multiplicity of digging speeds range from 15 in. to 25 ft per min. Double-action hydraulic rams actuate the wheel for loading and grading.



Three Speed Digging Wheel

Bucket widths possible with the 420 are 36 in., 42 in., and 48 in. Optional sidecutters to increase trench widths to 40, 46, and 52 in. are available. Maximum depth of trench is 7 ft 6 in. Buckets for the digging wheel are of formed steel, carry replaceable point type teeth and are available with either tine or solid backs. **Parsons Co., CE-12, P.O. Box 431, Newton, Iowa.**

## Folding Barricade

A NEW FOLDING BARRICADE for use on highway and construction projects or industrial maintenance jobs has been developed.

The barricade is painted the traditional yellow and black and meets state highway safety specifications. In addition, it is so designed that it is non-collapsible, even when subjected to wind pressure from large trucks. Sturdily constructed for long durability under severest weather conditions, it has steel legs, marine plywood cross bars, and the flasher light bolts on so that it is tamper-proof and theft-proof. **Pacific Mercury, CE-12, 14052 Burbank Blvd., Van Nuys, Calif.**

## New Digging and Loading Concept

BY UTILIZING THE FAST SWING of an excavator turntable and a 7-ft independent crowding action, the "Skooper" can go through numerous complete loading cycles while standing in one place. Job condition tests have shown it can load 400 tons per hour, operated with 70 hp. This amounts to 5.7 tons for each horsepower hour, an important economy feature in loading operations.

The virtual elimination of track movement, plus smooth swing and crowd action, cuts operator fatigue to a minimum and allows continuous full production. Transmission and track maintenance and wear are negligible.

The "Skooper" bucket cuts evenly up any angle of sloping bank, as well as on an accurate level grade. Crawlers can head into the digging or be set parallel to the bank, making full use of the turntable action. **Koehring Div., Koehring Co., CE-12, 3026 West Concordia Ave., Milwaukee 16, Wis.**

IT'S NEW / It's from DORR-OLIVER

THE SR CLARIFIER / . . . for RAPID sludge removal

The new SR Clarifier makes a THREE product separation of sewage. One, it rapidly removes fresh sludge from the floor of the final Clarifier through special vertical withdrawal pipes affixed to a partially submerged trough at the top of the tank. Two, it provides for positive removal of fine silt and other inorganic solids by continuous and positive scraping action to a center sump. Three, it provides for normal effluent overflow over the outside weir.

Advantages of the new SR over *all* competitive units are the positive visual evidence of sludge removal and the separate removal of inorganic solids by continuous raking movements which deposit solids in a central sump from where it is pumped periodically.

For more complete information on the new SR Clarifier for rapid sludge removal write Dorr-Oliver Incorporated, Havemeyer Lane, Stamford, Connecticut.

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# For simplicity of design and availability you can count on USS Structural Steel

**It is generally accepted** that the best design is the *simplest* design. This is especially true in bridges.

A clean, simple structure indicates that the designer refused to use one extra pound of material. He had a clear understanding of fabrication problems, so he carefully eliminated excess joints. He knew that *men* had to do the erection, so he selected familiar, easy-to-work-with materials.

For these reasons, most designers prefer to work with steel.

Steel is the most versatile of all building materials. It can be punched, sheared, hot-worked, welded, flame-cut, riveted or bolted. Members can be fabricated in the shop and erected in practically any kind of weather. It is unsurpassed for strength and impact resistance, and is available in a great range of shapes, sizes and strengths.

Long before the Interstate Highways Program was suggested, the steel industry saw the growing need for structural shapes and plates. New facilities were planned, and today they are steadily coming into production. Bridges that are on the drawing board today can count on these new facilities. Now, more than ever before, you can design with the material you know best, the material that offers the most—*you can count on steel.*

USS TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

**United States Steel**

KEEP OUR ROADS ON THE GO

Textile Mill, Kendall Mills, Inc., Bethune, S. C.
Engineers: Lockwood Greene Engineers, Inc., New York, N.Y.
Contractor: Daniel Construction Co., Greenville, S. C.

# Vibroflotation®

## was used to compact the sandy subsoil at this textile finishing plant. Included was the area beneath:

*A. All column footings*

*B. All wall footings*

*C. The sloping walls of a large water reservoir.*

Additional savings were realized through elimination of all formwork for footings. VIBROFLOTATION stabilizes granular soil so effectively that excavations retain neat, vertical walls even after placement of reinforcing steel and pouring of concrete.

A total of 1211 compactions were made to an average depth of twelve feet below bottom of footings. VIBROFLOTATION provided a substantial savings of about $29,000.00 over alternate foundation solutions considered, including piling and deep spread footings.

The sand wall of the Kendall Mills' reservoir was compacted on 7' to 8' centers in two concentric circles 100' and 108' in radius. Subsequently, the bottom and inside sloping wall were overlaid with reinforced concrete paving to form the lining of this 2,300,000-gallon reservoir.

**Proven Applications**

Deep Foundations • Dams
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ATlantic 1-2500


# EQUIPMENT MATERIALS and METHODS

## (continued)

### Tubular Bus Conductor

SUBSTANTIAL SAVINGS FOR USERS of smaller sizes of tubular bus conductor are promised with the introduction of the Universal Angle Bus Conductor. With this bus, direct bolted connection from cable connectors to bus is normally possible. Attachment to insulator supports is possible simply by using standard cap screws. A special convenience to users is a set of extruded lateral grooves. A pair of grooves, $1\frac{3}{4}$ in. apart, on each of the outer surfaces locates the center lines to drill holes for a standard tap. Single grooves on the inner surfaces locate the center line for drilling to attach directly to insulators. **Aluminum Company of America, CE-12, 1501 Alcoa Bldg., Pittsburgh 19, Pa.**

### New Rock Body

ONE OF THE LARGER dump bodies recently built by the company has been delivered to a firm in Southern Indiana for use in strip mining operations.

The special rock body was custom-designed and built for off-highway use in conditions requiring an oversized 16 x 9-ft body. A double-acting telescopic hoist to lift the 20-cu yd load and also to lower the body from its extreme 70-deg dumping angle was designed. Mounted on an

16x9-Ft Body

Autocar chassis, the unusually high dumping angle is necessary to scour the load from the body and provide quick unloading.

Constructed of 8 gauge steel shell, the body has a 2-in. oak cushion under the ¼-in. steel batter-plate. The triple floor construction enables the body to withstand the severe pounding of rock

*(Continued on page 148)*

# dependable·accurate·versatile

## LEUPOLD ABNEY LEVEL

4 STANDARD SCALES READY FOR INSTANT USE
- Degree
- Chainage Correction
- Topographic
- Per Cent

The only Abney Level supplied complete with all four commonly used scales — ready for instant use. No "extra" scales to misplace. Internal focusing bubble magnifier. Fast, convenient, accurate for leveling, checking grades, measuring heights, topographic mapping.

Length 6½" Weight 10 oz. $33.00 Furnished in saddle leather case, belt loop.

**LEUPOLD ABNEY LEVEL HANDBOOK**
Illustrates and describes how to make full use of your Abney Level. Furnished with each Leupold Abney, or send 25c per copy.

**LEUPOLD HAND LEVEL**
Pocket level for determining level, fall or grade. Internal focusing bubble magnifier. Furnished in saddle leather case with belt loop.
Lgth. 5¼" Wt. 3½ oz. $13.95

AT YOUR DEALER or write to factory.

**DEALERS:** Investigate this profitable line of LEUPOLD compasses, levels. Write for information.

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# Engineers agree...

Approved by Underwriters' Laboratories, Inc., *and The Associated Factory Mutual Fire Insurance Companies

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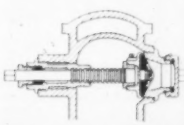
## California type HYDRANTS
## are preferred everywhere!

The most widely preferred design throughout the Western States, Panama, South America, Hawaii, the Philippines, South Pacific and Saudi Arabia. These improved hydrants have received the endorsement of fire chiefs, waterworks superintendents and engineers everywhere.

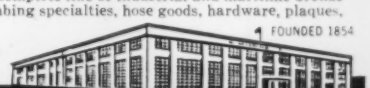
**SPECIFICATIONS**



- FAST BREAKING VALVE DESIGN
  Seat angle provides maximum efficiency, minimum resistance, quick opening and full flow of water. Eliminates water hammer and valve chatter at full 200 lbs. working pressure.
- Independent valve for each outlet
- Full 6¼" waterway
- Curved deflector head—assures full pressure by reducing friction.
- Simple construction. All bronze working parts and heavy cast iron body give long, trouble-free service.

We also manufacture a complete line of industrial and maritime bronze valves and fittings, plumbing specialties, hose goods, hardware, plaques, tablets and letters.

FOUNDED 1854



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# PRIVATE PRACTICE OF CIVIL ENGINEERING

THE Society's Committee on Professional Practice has spent several years on the revision of Manual 29. The result of this work is now available as Manual 38, "Private Practice of Civil Engineering for the Use of Engineers and Clients."

*If you wish to receive a copy of this Manual, please use the accompanying order form.*

----------CUT HERE----------

**American Society of Civil Engineers**
**33 West 39th Street, New York 18, N. Y.**

Please send ..... copy(s) of Manual 38 at a list price of $1.00 (50% discount to ASCE members). Enclosed is my remittance. Grade .....

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*Print Name*

STREET .....

CITY ..... ZONE ..... STATE .....

OF M-38

(continued)

dropped from a power shovel. The scow type end eliminates the necessity of a tailgate. **Galion Allsteel Body Co., CE-12, Galion, Ohio.**

## Epoxy Paste

A NEW EPOXY PASTE which is capable of curing firm and hard in underwater locations has been produced. The paste used in the application is identified as Epocast 546 which, in combination with Hardener 9514, will cure in wet locations such as sewer pipes, underground installations, wet concrete, and in marine areas where considerable quantities of moisture prevail.

After Epocast 546 has been combined with its hardener, it may be trowelled or squeegeed into position. Hardening takes place in several hours and unlike usual epoxy formulation it will get quite hard overnight under moist conditions, and will develop good adhesion to clay pipes, to concrete products, to stone, to metals, and to other miscellaneous products. **Furane Plastics Inc., CE-12, 4516 Brazil St., Los Angeles 39, Calif.**

## Von Arx Pistol

OPERATING ON COMPRESSED AIR, this new light weight pistol is a tool for the de-rusting, de-scaling, cleaning and surface preparation of practically all materials.

Compressed air from any normal industrial type compressor drives the hardened steel needles, which, with their impact on a spring-loaded recoil movement, rapidly remove scale and rust, even from the most inaccessible points, using easily fitted specially designed adaptor heads if required. The action is controlled by a trigger on the handle. Air continually flows over the working surface, removing rust or paint, and leaving the surface visibly clean. Normal working pressure is 88 psi and air consumption is 12.5 cu ft/min. **The Marindus Company, CE-12, 52 Wall Street, New York 5, New York.**

Light Weight

## Translucent Building Panel

A UNIQUE COMBINATION of fiberglass and aluminum, the Kalwall Panel is fast coming into the spotlight of world attention. The U. S. Pavilion at the World's Fair in Brussels, designed by Architect Deward D. Stone, is roofed with 2,052 lightweight panels supported by purlins which, in turn, are carried by 36 steel cables. A special joint system maintains constant pressure and permits expansion to be taken up within the panel's own area.

A sandwich construction of polyester impregnated fiberglass bonded to a

(Continued on page 150)

HOW LONG IS A LONGSPAN JOIST?

HAVEN-BUSCH Company
SINCE 1888

DESIGNERS — FABRICATORS — ERECTORS

T-Chord* Longspan Joists Structural Steel

Miscellaneous Iron

3445 CHICAGO DRIVE, S.W.—GRANDVILLE, MICH.
PHONE: LEnox 2-3641

*T.M. Reg.

**The longest structural steel joist** made is a 150 foot T-Chord* Longspan Joist produced exclusively by Haven-Busch Company. While most other joists run less than 100 feet in length, Haven-Busch makes this extra long joist (half the length of a football field) to give architects and builders greater leeway in planning large clearspan, column-free interiors for such buildings as a bowling alley, fieldhouse, gymnasium or auditorium.
It is because of products such as this 150 foot long joist — and the men who make it — *that better building begins with steel by Haven-Busch.*

## EQUIPMENT MATERIALS and METHODS

**(continued)**

locked aluminum grid, the panel comes in two thicknesses and nine colors and measures four feet wide by 8, 10, 12, and 20 ft long. Tests show a panel carried 1½ tons per lineal foot, has a low coefficient of expansion and has passed numerous flame tests. **Kalwall Corp., CE-12, 43 Union St., Manchester, New Hampshire.**

### Rear Dump Trailer

EFFORTLESS MANEUVERABILITY and smooth, controlled dumping are the keynote of the Model TS-1622 Rear Dump, Variable Wheel Base Trailer. Designed for use in perfect balanced combination with the Euclid Model S-12 Tractor, it will be known as the S-12 Rear Dump. All tractor and trailer tires are interchangeable, and the trailer tires, wheels and brake parts are interchangeable with those on the Euclid Model S-12 Scraper.

Smooth, Controlled Dumping

Rated capacity of the trailer is 22 tons, based on materials weighing 2700 lb per cu yd.

Its ability to maneuver easily through tight turns is a distinctive feature. When the trailer is in travel position, the power-steered tractor can be cut to a 90-deg angle, permitting the unit to turn within a width approximately equal to its overall 28-ft-8-in. length. In dump position, the wheel base is shortened by 5 ft 6 in., which permits turning within a width of 24 ft. **Easton Car & Construction Co., CE-12, 36 Holley St., Easton, Pa.**

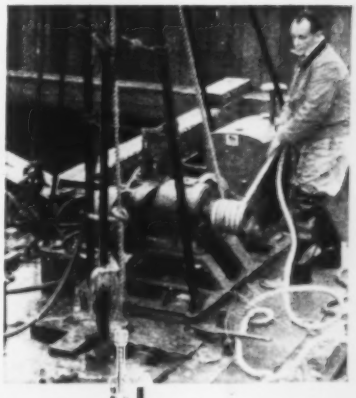
### Hydraulic Bending Machine

A COMPACT HYDRAULIC BENDING machine that bends pipe or thin wall tubing up to three inches in thickness ac-

*(Continued on page 150)*


**acker** Portable, Power Operated Soil Sampling Rigs

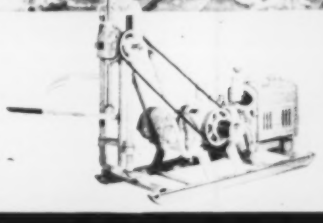
Acker power operated soil sampling rigs combine into a compact, portable unit a standard power plant together with powerful hoisting winch and pump. Two models are available — Acker Model RGT for light duty and Acker RG for heavy duty service. These relatively inexpensive units are ideal for soil sampling, jetting and driving pipes or piles.



**More for Your Money!**

Add an *Acker rotary drill head* for rock coring and foundation test boring.

The Acker Model SK rotary drill head when combined with Acker RGT and RG rigs make an ideal unit for rock coring and foundation test boring. For complete information, write today for bulletin 28-CE.



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*A complete line of Soil Sampling Tools, Diamond and Shot Core Drills, Drilling Accessories and Equipment.*

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**THIS IS THE STATION THAT IS PREFABRICATED AND DELIVERED TO JOB SITE READY TO OPERATE**

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**ZIMMER & FRANCESCON** P. O. BOX 359, MOLINE, ILLINOIS

# STANPAT SOLVES THE GHOSTING PROBLEM

**NEW resin-base STANPAT ELIMINATES GHOSTING, offers better adhesion qualities on specific drafting papers!**

**THE PROBLEM**
Some of our longtime customers first called our attention to the "ghosting" problem. Certain tracing papers contain an oil which could be leeched out by the STANPAT adhesive (green back) causing a ghost.

**THE SOLUTION**
A new STANPAT was developed (red back), utilizing a resin base which did not disturb the oils and eliminates the ghost. However, for many specific drafting papers where there is no ghosting problem, the original (green back) STANPAT is still preferred.

**WHICH ONE IS BEST FOR YOU?**
Send samples of your drawing paper and we will help you specify. Remember, STANPAT is the remarkable tri-acetate pre-printed with your standard and repetitive blueprint items—designed to save you hundreds of hours of expensive drafting time.

**SO SIMPLE TO USE**

**1. PEEL** the tri-acetate adhesive from its backing.

**2. PLACE** the tri-acetate in position on the tracing.

**3. PRESS** into position, will not wrinkle or come off.

**STANPAT CO.**
WHITESTONE 57, N. Y., Dept. 73
Phone: FLushing 9-1693-1611

STANPAT CO. Whitestone 57 N. Y. U.S.A.

- ☐ Enclosed are samples of the drafting paper(s) I use (identify manufacturer). Please specify whether Rubber Base or Resin Base STANPAT is most compatible with these samples.
- ☐ Send literature and samples of STANPAT.
- ☐ Please quote price on our enclosed sketches which we are considering to have pre-printed.

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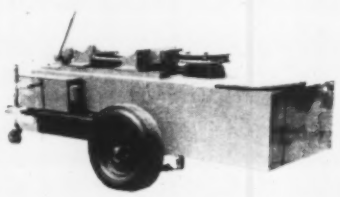
## EQUIPMENT MATERIALS and METHODS

**(continued)**

curately at angles up to 180-deg in a single operation is now available.

Any type of bend can be made on the Model 3 bender, including offset and reverse, and accurate repeat bends are possible by setting the easily adjusted limit stops. Maximum distortion of cross-section is less than 2%.

Virtually maintenance-free except for



Model 3 Bender

periodic lubrication of moving parts, the bender uses a 3-hp, 3-phase 220/440-volt motor for electrical power. All exposed electrical components are weatherproofed, and a magnetic starter with overload protection is furnished. **Engineering Associates, CE-12, 6547 West Blvd., Inglewood, Calif.**

### Horizontal Cylinder Capper

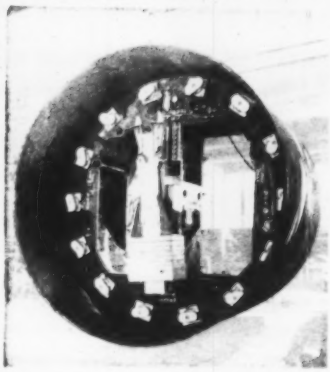
BY ELIMINATING GUESSWORK, AND producing acceptably plane and parallel caps of identical thickness, with no heavy overhang around the edges, the Double-header horizontal cylinder capper is said to substantially reduce the cost of capping, and to consistently produce perfect caps that result in higher psi readings. The manufacturer states that it is easy to operate, reasonably priced, and weighs less than 30 lb. **Forney's Inc., Tester Division, CE-12, P.O. Box 310, New Castle, Pa.**

### High-Capacity Jib

A COMPLETELY NEW STYLE job is now available for the company's K-300 and K-600 Series cranes. The basic two-piece 20-ft jib has a maximum capacity of 10 tons and by means of 10-ft sections, it can be extended to a 30 or 40-ft length.

Greater capacities are made possible through the use of high strength alloy steel construction which gives increased strength-to-weight ratio. Other advantages include the job peak sheave and strut deflector sheaves mounted on needle bearings. **Link-Belt Speeder Corp., CE-12, Prudential Plaza, Chicago 1, Ill.**


# MAYO SANDHOG EQUIPMENT



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## Literature Available

SOUTHERN PINE MANUAL—The 16th edition of the Southern Pine Manual Of Standard Wood Construction, a revised and modernized version of a famous reference book for architects, engineers and builders, is now available. The new manual has been enlarged to include up-to-date design data on modern applications such as laminated lumber and heavy timber roof decking. New tables, additional formulas and information on standards relating to lumber construction are also presented. The cost is $2.00 per copy. **Southern Pine Association, CE-12, P. O. Box 1170, New Orleans 4, La.**

METAL LATHING & FURRING—Technical points referred to in this 20-page booklet entitled "Specifications for Metal Lathing & Furring" include: specifications for solid and hollow partitions; contact, furred, and suspended ceilings; wall furring; metal lath attached directly to wood supports; beam and column protection for fireproofing; and reinforcing for exterior stucco. In addition to descriptive tables summarizing the various spans and spacings for supporting metal lath and plaster ceilings, the brochure includes a page devoted to fire-resistive ratings. **Metal Lath Manufacturers Association, CE-12, Engineers Building, Cleveland, Ohio.**

LAYING FLOORING—A two-page bulletin describing the four-step process for laying heavy-duty, heat-resistant flooring is now available. The booklet shows how to lay Emeri-Brick in order to obtain maximum heat and thermal shock resistance under a variety of commercial applications. Six illustrations supplement the description of materials and steps used in laying Emeri-Brick floors. Cost and time-saving factors are also discussed. **Walter Maguire Co., Inc., CE-12, 60 East 42nd St., New York 17, N. Y.**

PRELOAD CONCRETE TANKS—Bulletin T-22 covers the history of prestressed concrete tanks in the United States and abroad with a description of several recent record breaking storage tanks. It also gives details on design, construction, cost estimating and maintenance of prestressed concrete tanks. Some of the advantages of prestressed concrete are: economical first cost, standard, proven design, and architecturally pleasing. **The Preload Co., Inc., CE-12, 211 East 37th St., New York 16, N. Y.**

SCREEN PIPE—A new eight-page catalog describing screen pipe for oil, gas and water wells, including the "More Area" Slotted Screen Pipe, Vertical Slotted and Drilled Hole Wire Wrapped Screen, and Prepacked Gravel Pack Screen, together with specifications of various types, is now available. Photographs are also included. **Emsco Screen Pipe Co., CE-12, P.O. Box 14446, Houston 21, Texas.**

F/S OPTICAL PLANIMETER
Model 236/A
Eyestrain and parallax in contouring the figure are eliminated by the optical tracer. No need for subtracting the initial reading or adjusting the counting wheel manually.
• Tracing lens providing large magnification
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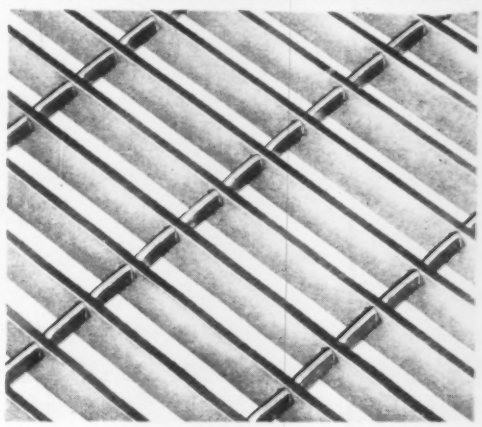
**NEW!**

**Gary-Galok® SUPER ALUMINUM GRATING**



**First improvement in rectangular mesh grating in over a quarter-century!**

- High strength-to-weight ratio.
- Cross bars can't turn, come loose or fall out.
- All sizes—¾" x ⅛" to 2¼" x 3/16".
- Standard mesh with main bars on 1 3/16" centers and close mesh with main bars on .915 centers with cross bars on 4" or 2" centers.
- Safe, slip-proof surface.
- Available in plain or serrated main bars.

*Patents Pending

You'll want full details about this new aluminum grating. Write for Bulletin CE-128.

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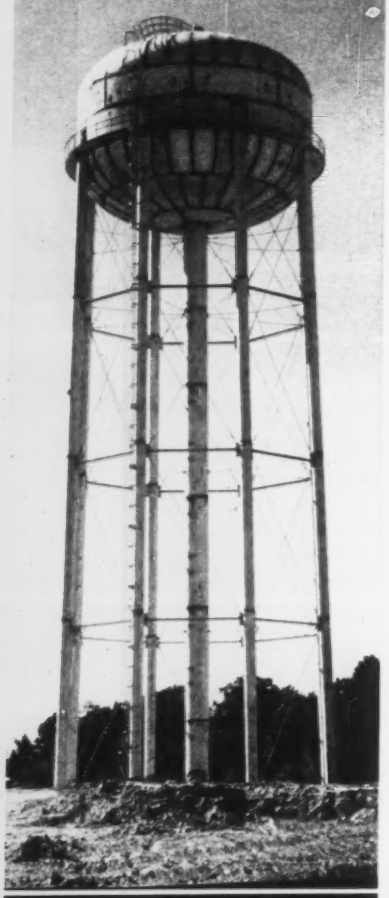

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# Literature Available

LIGHTWEIGHT AGGREGATE CONCRETE—A newly published brochure illustrates the wide use of lightweight aggregate concrete in modern construction. Photographs and job stories present a clear picture of the wide variety of uses for this relatively new and versatile building material. Thirteen construction projects are featured with discussion covering the use of lightweight concrete as a strong, durable structural material for columns, beams and floor slabs, and in multi-story structures, thin shell concrete and bridge decks. **The Master Builders Co., CE-12, 7016 Euclid Ave., Cleveland 3, Ohio.**

SPLIT-LEVEL ROOF—How the Green Acres School in Birmingham, Alalgama, made use of a split-level roof design to provide more natural light in its classrooms is explained in a six-page folder. The unusual roof design was simplified through the use of precast concrete roof slabs installed on a steel frame. An uninterrupted window wall and clerestory run the length of the building. Details and photographs of the school's structural system are included in the booklet. **Flexicore Co., Inc., CE-12, 1932 E. Monument Ave., Dayton 1, Ohio.**

FORGED STEEL UNIONS—A new simplified catalog, providing complete information on construction of the company's full line of forged steel unions and union fittings has been published. Prepared especially for contractors, purchasing agents, pipeline crews, engineers, and mechanics, the 16-page, loose-leaf-style folder contains detailed specifications on Petro, Handlebar, Hydro, Mark, and Orifice unions, check valves and forged steel fittings, ranging from 2,000 lb through 6,000 lb CWP. **Clayton Mark & Co., CE-12, 1900 Dempster St., Evanston, Ill.**

TAPES—Over 550 pressure-sensitive tapes of many sizes, colors, and patterns for making graphs, charts, layouts, printed circuit drawings, map overlays, slides, and other presentations, are illustrated in a new enlarged 32-page booklet "Visualization Made Easier". Included in the brochure are step-by-step directions for making office and plant layouts, and organization and flow charts. The draftsman will find facsimiles of opaque and transparent tapes, which will enable him to reproduce his presentations by diazo or other standard reproduction processes. **Chart-Pak, Inc., CE-12, Leeds, Mass.**

QUARTERLY NEWSLETTER—The first issue of a new quarterly newsletter entitled "The Zinc Spotlight" has been published. This 4-page booklet has been created to bring a wide variety of news about zinc and the zinc industry of special interest to engineers, designers, fabricators, management, and students. **American Zinc Institute, Inc., CE-12, 60 East 42nd St., New York 17, N. Y.**

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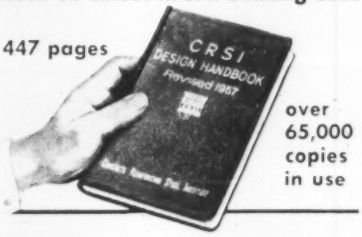


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## From the MANUFACTURERS

**AD & PROMOTION CAMPAIGN:** The Master Builders Co., one of the largest producers of admixtures for concrete, has announced the selection of the Griswold-Eshleman Co. of Cleveland, Ohio, as its advertising agency and public relations counsel. The Master Builders advertising account was sought by several of the nation's largest ad agencies, with the selection of Griswold-Eshleman coming after months of deliberation and evaluation . . . **DISTRIBUTOR APPOINTED:** Bowman Steel Corp., Pittsburgh, Pa., is now the sole distributor for the industrial and commercial building products manufactured by the American Steel Band Co. and the Hunt Construction Co. . . . **NEW QUARTERS:** With new laboratory and administrative quarters completed recently, more than 100 personnel of Allis-Chalmers Nuclear Power Div. have moved operations to the Greendale laboratories, located on a 30-acre site in suburban Greendale, Wis. . . . Filotecnica Salmoraghi, Inc. of Long Island City, manufacturers of surveying equipment, will occupy new and enlarged quarters at 254 Fifth Ave., New York 1, N. Y. . . . **NET INCREASE:** Net income of Penn-Dixie Cement Corp. for the nine months ended Sept. 30, 1958 totaled $6,311,019, an increase of 49% over net income of $4,229,925 in the comparable period of 1957 . . . **INDUSTRIAL EXPANSION:** Operation "Third Phase", an industrial expansion program involving $2 million, has just been initiated by Cleaver-Brooks Co., Milwaukee, Wis., originator and leading manufacturer of packaged boilers for industrial, institutional and commercial application . . . **ADVERTISING AWARD:** LeTourneau-Westinghouse Co. of Peoria, Ill., has received a top advertising honor, an award from the Direct Mail Advertising Association, Inc., for its mail advertising during the year which ended August 1 . . . **PLANT ACQUIRED:** Consolidated Metal Products Corp., Albany, New York, has acquired the Waldale Research Co., Inc. of Pasadena, Calif., a manufacturer of electronic strain measuring devices . . . **TELEVISION EQUIPMENT:** Kin Tel Div. of Cohu Electronics, Inc., San Diego, Calif., has announced receipt of a $300,000 order from Douglas Aircraft for closed circuit television equipment, which will be installed at Camp Vanderberg, an operational missiles site near Lompoc, Calif. . . . **PURCHASE ANNOUNCED:** The American Meter Co., manufacturers of gas meters and industrial instruments, reported that its subsidiary, Buffalo Niagara Industrial Controls, Inc., has purchased the Buffalo Meter Co. of Buffalo, N. Y. . . . **APPOINTMENTS:** The appointment of L. R. Greenhaus as general manager of sales, eastern division, of Luria Engineering Co. has been announced . . . D. L. Douglass will head the new marketing division at Thew Shovel Co., Lorain, Ohio.


**LABYRINTH® WATERSTOPS**

**A SOUND INVESTMENT FOR CONCRETE CONSTRUCTION!**

LABYRINTH AVAILABLE IN 2, 3 or 4 rib.

**ON YOUR CONSTRUCTION:**

**1.** Consider the investment in design, materials and labor (to mention a few).

**2.** Then consider how important safe, secure *watertight* concrete joints are.

**3.** Thorough watertightness *can* be secured by installing Labyrinth Waterstops—a dividend that makes the low initial cost of the product insignificant when compared to your total investment—and one that insures watertight concrete joints for years!

- Corrugated ribs grip concrete, insure an everlasting bond between joints.
- Finest polyvinyl plastic resists chemical action, aging, severe weather.
- Takes just seconds to nail to form . . . easy to cut and splice on location (prefabricated fittings available).
- There's a Water Seal product for every type of concrete work!

If your aim is to stop water seepage, *stop it effectively with Water Seals' Waterstops!*

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# PROCEEDINGS AVAILABLE

**1766. Irrawaddy River System of Burma, by John B. Alexander and Henry R. Norman. (WW)** This paper examines transportation conditions of the Irrawaddy River system of Burma up to 1953, including the pre-war, wartime, and the post-war system.

## November

**Journals:** Hydraulics, Sanitary Engineering, Structural, Surveying and Mapping

**1833. Wave Forces on Submerged Structures, by Ernest F. Brater, John S. McNown and Leslie D. Stair. (HY)** The magnitude and characteristics of forces resulting from oscillatory waves were determined for models of submerged barge-like structures.

**1834. Snowmelt Runoff, by J. Harold Zoller and Arno T. Lenz. (HY)** Factors relating to the melting of snow were evaluated for the snowmelt periods of 1938 through 1952 for the Big Eau Pleine River in Wisconsin. Convection and condensation melt potentials were computed from equations developed by previous investigations.

**1835 Hydrological Aspects of Radioactive Waste Disposal, by William H. Bierschenk. (SA)** Geologic and hydrologic data have made it possible to predict the behavior of low-level radioactive wastes. At no time in the plant's history has the underground movement of radioactive wastes resulted in detectable amounts reaching points of public access.

**1836. Blast Phenomena From a Nuclear Burst, by Ferd E. Anderson, Jr. (ST)** This paper describes the air blast and ground shock free field phenomena associated with a nuclear burst. The data presented extend that presented in the publication, "The Effects of Nuclear Weapons."

**1837. Blast Loading Structures, by H. L. Murphy. (ST)** An examination of blast loading on structures is presented in terms of nuclear blast phenomena and is related to closed rectangular structures located above ground, semi-buried, and underground.

**1838. The Factor of Safety in Design of Timber Structures, by Lyman W. Wood. (ST)** Reduction in the average strength of clear wood is made necessary by the conditions of structural use. A way to estimate safety is to use near minimum values for these conversion factors and make a further reduction for unforeseen conditions.

**1839. Light Wood Trusses, by R. F. Luxford. (ST)** Strength tests were made on trusses with spans ranging from 17 to 32 feet, and with slopes from 5 in 12 to 1 in 12. It was found that glued trusses are stronger and stiffer than nailed trusses.

**1840. Glued Laminated Wood Constructions in Europe, by M. L. Selbo and A. C. Knauss (ST)** History and current status of wood laminating industry is reviewed. Adhesives, wood species and production methods are compared with U.S.A. practices.

**1841. Pressure Preserved Wood for Permanent Structures, by C. Miles Burpee. (ST)** This paper explains how modern science has developed preservatives that insure long service, how the evaluation of soil investigations can lead to the design of more economical foundations, and why pole-type buildings are becoming popular for industrial and commercial uses.

**1842. Highway and Bridge Surveys: Preliminary Bridge Surveys. Progress Report of the Committee on Highway and Bridge Surveys of the Surveying and Mapping Division. (SU)** This paper treats the details of conducting the surface and hydrographic surveys for long-span bridges over water and examines the requirements of the Geological and Foundation Survey.

**1843. Charts for the Air Force, by Richard W. Philbrick. (SU)** Charts for the United States Air Force are published by the Aeronautical Chart and Information Center. The latest photogrammetric and cartographic techniques are used. About one hundred million charts a year are distributed throughout the world.

**1844. The State Responsibility Towards Surveying and Mapping, by Burton R. Ingalls. (SU)** The state has a responsibility for an adequate surveying and mapping program. There is a need for a new type of service. A new type of state agency can provide this.

**1845. The Illinois and Michigan Canal State Property Survey, by Charles D. Mitchell. (SU)** This paper gives the history of the Illinois and Michigan Canal and the present day problem of re-establishing the boundary lines with those made upon completion of the Canal in 1847-1848.

**1846. Photogrammetry Aids in Pipeline Location Surveys, by Alfred O. Quinn. (SU)** New techniques make photogrammetry an invaluable aid to pipeline location engineers. Combined use of aerial photography, topographic maps, and detailed studies of terrain helps to select feasible routes at minimum time and expense. Integrated photogrammetric programs provide the necessary basic surveying and mapping data.

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**1847. Sleuthing the Behavior of a River, by Edward J. Cleary. (SA)** Seven years ago the Ohio River Valley Water Sanitation Commission instituted a program for systematic surveillance and appraisal of quality conditions and flow variations. The program is described in detail.

**1848. Forests and Water Yield, by Nedavia Bethlahmy. (SA)** The paper reviews the problems involved in the yield of water from forest areas.

**1849. Anaerobic Contact Process for Treatment of Suburban Sewage, by J. L. Witherow, J. B. Coulter and M. B. Ettinger. (SA)** Pilot plant studies are described on an anaerobic contact process incorporating simplicity of design and absence of moving parts for treatment of domestic sewage. The process which produces an effluent low in B.O.D. and suspended solids is being developed for small groups of houses.

**1850. An Analog Computer for the Oxygen Sag Curve, by Morton D. Sinkoff, C. Don Geilker, and Jan G. Rennerfelt. (SA)** The theory of an electrical analogy to the Streeter-Phelps oxygen sag equation is described. The analogy is applied in the construction of an instrument for use in the solution of exponential functions similar to the B.O.D.-time relationship and the oxygen-sag curve. The uses of such a computer in the field of stream pollution control are presented.

**1851. Administration of Air Pollution Control Laws in Oregon, by Richard E. Hatchard. (SA)** This paper presents the background of the Oregon Air Pollution Authority and its relationship with local agencies. Prevention and current needs as well as the role of the engineer are reviewed.

**1852. Municipal Composting in the United Kingdom, by C. A. Gordon. (SA)** Two municipal composting plants operating in the United Kingdom are described. The general trend in refuse disposal is outlined.

**1853. SED Research Report No. 21. Sanitary Land Fill Tests Investigating Refuse Volume Reduction and Other Phenomena, by the Solid Wastes Engineering Section of the Sanitary Engineering Research Committee. (SA)** The results of tests made to ascertain compaction, settlement, fill temperature, and gas production are presented. These data are reviewed with reference to obtaining optimum refuse disposal volume into a given landfill area.

**1854. Design of Pier Bent and Rigid Frame, by Charles P. C. Tung. (ST)** This paper presents the procedure of using moment distribution in the design analysis of pier bent or rigid frame by electronic computation. Sample solutions from the completed program, coded for the LGP, are illustrated.

**1855. Discussion of Proceedings Paper 1463, 1592, 1608, 1612, 1678, 1714, 1717. (SA)** A. L. Danis closure to 1463. Remig A. Papp, Frank P. Coughlan on 1592. John W. Hamblen on 1608. Quintin B. Graves and Don Branscome closure to 1608. Gordon E. Mau on 1612. John R. Thoman on 1678. Harvey F. Ludwig on 1714. Thomas R. Camp on 1717.

**1856. Discussion of Proceedings Paper 1198, 1450, 1451, 1452, 1453, 1528, 1530, 1582, 1588, 1661, 1663. (HY)** J. C. Stevens closure to 1198. J. M. Robertson on 1450. C. O. Clark on 1451. J. L. H. Paulhus and J. F. Miller closure to 1451. Donald P. Thayer on 1452. Robert B. Jansen closure to 1452. M. R. Carstens closure to 1453. A. J. Peterka and J. N. Bradley on 1528. James M. Robertson on 1528. Donald R. F. Harleman on 1528. Philip G. Hubbard on 1528. R. J. Garde and M. L. Albertson on 1530. D. C. Bondurant on 1530. John L. Bogardi on 1530. Marvin J. Webster on 1582. Quintin B. Graves and Don Branscome on 1588. E. Shaw Cole on 1588. Claud C. Lomax on 1588. H. Alden Foster on 1661. Gordon R. Williams on 1663. H. Alden Foster on 1663.

**1857. Discussion of Proceedings Paper 1353, 1355, 1356, 1562, 1567, 1630, 1631, 1633, 1636, 1637, 1638, 1696, 1710, 1722. (ST)** James Chinn closure to 1353. Edward Cohen and Henri Perrin closure to 1355. Edward Cohen and Henri Perrin closure to 1356. Alexander Dodge corrections to discussion. Lembit Kald on 1567. Frederick H. McDonald on 1630. Victor R. Bergman on 1631. Octave W. Imer on 1633. Winfield H. Eldridge on 1636. John Reno on 1637. Yves Nubar on 1638. Zdenek Sobotka on 1638. I. Chen Chang on 1638. George W. Housner on 1696. Herbert S. Saffir on 1710. Dronnadula V. Reddy on 1722.

**1858. Discussion on Proceedings Paper 1697. (SU)** William A. White on 1697.

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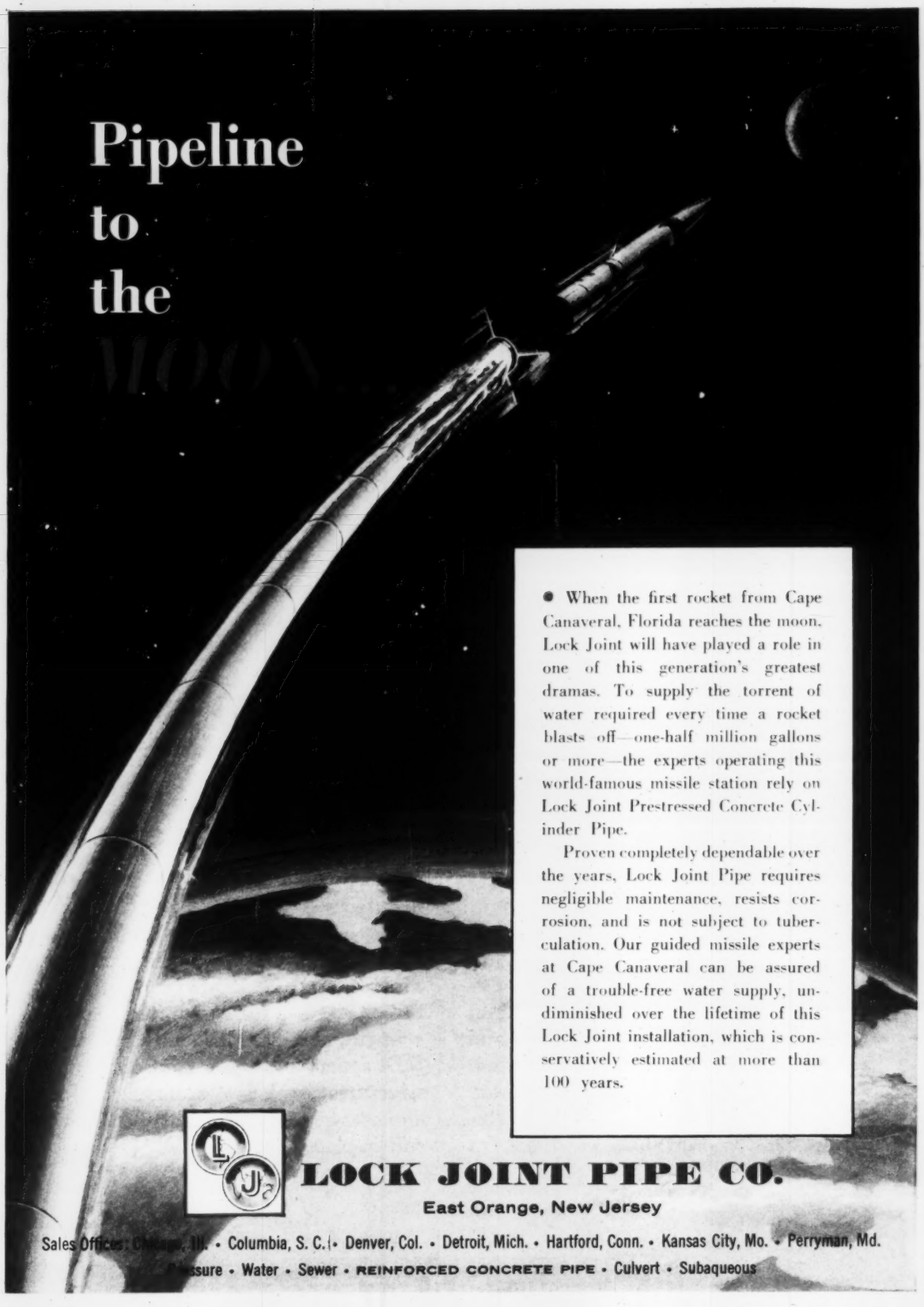


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